



# **PULSAR® DLC-XPRC**

DIGITAL STROKE LENGTH CONTROLLER

NEMA 7 Option

## **Installation, Operation & Maintenance Instruction**

**Bulletin No. PR- IOM - XPRC-0301-C**

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# DLC-XP/RC™ FACTORY SERVICE POLICY

Your DLC-XP/RC™ is a state of the art microprocessor-based stroke length control device for use with PULSAR® Diaphragm Metering Pumps. It includes extensive on-board diagnostics. If you are experiencing a problem with your DLC-XP/RC, first review the diagnostic menu, then consult the trouble shooting guide. If the problem is not covered or cannot be solved, please contact your local Pulsafeeder Sales Representative or our Technical Service Department at (585) 292-8000 for further assistance.

Trained individuals are available to diagnose your problem and arrange a solution. Solutions may include purchasing a replacement unit or returning the DLC-XP/RC to the factory for inspection and repair. All returns require a Return Material Authorization (R.M.A.) Number to be issued by Pulsafeeder.

Replacements purchased under a possible warranty situation may be credited after an examination of the original DLC-XP/RC by Pulsafeeder personnel.

Certain components may be purchased for replacement in the field. Parts purchased to correct a warranty issue may be credited after examination of the original parts by Pulsafeeder. Parts returned for warranty consideration that are good will be sent back freight collect.

Any field modifications will void the Pulsafeeder DLC-XP/RC warranty. Out-of-warranty repairs will be subject to Pulsafeeder's standard bench fees and testing costs associated with replacement components.

**This document describes product features controlled by ATEX requirements. Those features, and this document, can not be changed without notification or approval of the appropriate agency.**

## Revision History

Rev C (09-27-2007)

- Started revision history
- Added ATEX statement above
- Other minor text changes throughout

## FCC Warning

This equipment generates and uses radio frequency energy. If not installed and used properly, in strict accordance with the manufacturer's instructions, it may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures necessary to correct the interference.

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# 1. Introduction

The DLC–XP/RC is a microprocessor based stroke length control device for use with the PULSAR diaphragm metering pump. It has been designed with many advanced features that allow the PULSAR to operate in a wide variety of industrial environments.

This instruction manual covers the DLC–XP/RC - Digital Stroke Length Controller for NEMA 7 installations. Refer to **Table 1** for the specific standard features and options for your model. All standard features are covered in this manual and most options have instructions where applicable.

For information specific to the metering pump itself, please consult the appropriate IOM. This document contains information on the electronic controller only.

## 1.1 Description

The DLC–XP/RC is an electromechanical servo controller dedicated to the PULSAR diaphragm metering pump series. The stroke control mechanism is physically attached and integrated into the pump's design. The control and user interface is located remotely to the pump -- in a safe environment. The purpose of the DLC–XP/RC is to precisely adjust output flow of a process media by means of stroke length positioning.

The DLC–XP/RC is designed for the international industrial market. The device is factory configured and calibrated for the attached pump. The man/machine interface is user friendly. Local setup and control is achieved through the nine button keypad and a back-lit two-line liquid crystal display. Basic operation is simple with dedicated function keys eliminating the need for a sophisticated menu system. The DLC–XP/RC responds immediately to user commands. Pump output is displayed as a percentage of stroke length position or in units of calibrated flow: GPH, LPH, CCH, GPM, LPM, CCM. In addition, the DLC–XP/RC display supports any one of four standard languages: English, French, German, or Spanish.

Analog signals and serial communications offer flexible remote control. They are fully isolated from each other as well as earth ground for improved protection and reliability. Time-based batching, with up to three independent programs, supplements the control features and allows for greater flow turndown.

The DLC–XP/RC is designed to simplify and automate the calibration of pump flow and analog signals. Flow calibration uses on-screen prompting, automated pump operation, and automatic curve fitting to eliminate stop-watches, calculators and human inaccuracies. Analog signal calibration is also accomplished by simple key-pad entry. It includes a real-time display of signal level. This eliminates the need for external meters.

The DLC–XP/RC readily accepts PULSAlarm® leak detection and drum level inputs. These may be configured to stop the pump and/or activate an alarm relay. Alarms are time and date stamped into memory for later retrieval. Other diagnostics include analog signal failure and line power failure. These are time and date stamped as well and may be preset to control stroke position or motor status upon detection.

### 1.1.1 Standard Features

- Digital stroke length control for PULSAR and SHADOW model pumps
- User keypad
- Back-lit 2 x 16 LCD display
- Solid state PULSAR motor control relay
- 4-20mA input and output
- 10-Year battery backed clock and configuration memory
- Solid state digital outputs
- Drum level / Remote start input
- PULSAlarm® Leak Detection interface
- Diagnostics built into software

Security states may be activated to prevent unwanted tampering. All settings and diagnostics are battery backed up to 10 years in absence of power.

The DLC-XP/RC is available in any combination of 120/240 VAC, 50/60 Hz, this configuration must be specified at time of order.

## 2. Safety Considerations

The DLC-XP/RC is a sophisticated microprocessor based controller for use only with PULSAR diaphragm metering pumps. It yields tremendous control capacity -- electrical, mechanical and (in conjunction with the PULSAR pump) hydraulic in nature. In consideration of SAFETY, the user should be mindful of this relative to his/her safety, that of co-workers and of the process environment. Please consider the following prior to the installation and operation of a DLC-XP/RC controlled PULSAR metering pump:

### 2.1 General Safety

The DLC-XP/RC was designed as a stroke length position actuator for operation solely with the PULSAR metering pump. Use for any other application is considered un-safe and voids all certification markings and warranties.

### 2.2 Explosive Atmosphere Safety



**WARNING -- EXPLOSION HAZARD -- DO NOT PERFORM INSTALLATION/MAINTENANCE OF ANY KIND ON THIS DEVICE WHILE CIRCUIT IS LIVE AND/OR THE AREA IS KNOWN TO BE HAZARDOUS.**

With the proper marking, the DLC-XP/RC is suitable for use in Class I, Division 1, Group C & D and Class I, Zone 1, Group IIB or non-hazardous locations only. The DLC-XP/RC will be marked for use Div. 2 / 2 one 2 or non-hazardous locations only.

The control chassis of the DLC-XP/RC is not suitable for use in a hazardous environment and must be remotely located in a safe area. Wiring between the two units must conform to local, state, and national codes and requirements.

### 2.3 Electrical Safety

The DLC-XP/RC can be considered an industrial controller with an integrated single phase motor starter. Improper application and use can be hazardous. The user is solely responsible for its use.

Electrical installation must conform to all location relevant electrical codes. Installation and electrical maintenance must be performed by a qualified electrician. Before installing or servicing this device, all power must be disconnected from the source at the main distribution panel.

The DLC-XP/RC emits electro-magnetic energy and generates radio frequency interference. Its use is restricted to industrial applications. The user bears all responsibility for shielding this energy/interference.

### 2.4 Mechanical Safety

When properly installed, the device has no external moving parts. The DLC-XP/RC should not be operated without its cover installed. When under power, the DLC-XP/RC is under computer control and as such may actuate without warning to the user.

### 2.5 Hydraulic Safety

Thoroughly review and adhere to the contents of the appropriate pump IOM for installation of your PULSAR metering pump. As a microprocessor controlled device, the DLC-XP/RC may activate the pump motor without warning to the user -- generating hydraulic pressure and fluid flow. Care should be taken to protect both users and system from such conditions.

### **3. Equipment Inspection**

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage must be reported within 30 days of receipt of this equipment to the freight carrier and your PULSAFEEDER Representative.

### **4. Storage Instructions**

The DLC-XP/RC can be successfully stored for extended periods. The key to this success is control of temperature and humidity.

#### **4.1 Short Term (0 - 12 months)**

The DLC-XP/RC should be stored in a temperature and humidity controlled environment. It is preferable to keep the temperature constant in the range of -18 to 60° Celsius (0 to 140° Fahrenheit). The relative humidity should be 0 to 90% non-condensing. The adjustment knob should be rotated by hand one full revolution every six months.

If the DLC-XP/RC is installed on the pump, it should not be removed during this period - provided the above conditions can be applied to the pump as well. If the DLC-XP/RC is removed from the pump, it should be stored in the same pump mounted orientation. After removal, seal the eccentric box opening with a dust and moisture proof material. If the DLC-XP/RC was shipped in its own carton, it should be stored in that carton.

#### **4.2 Long Term (12 months or more)**

Storage of the DLC-XP/RC for periods of longer than twelve months is not recommended. If extended storage is un-avoidable the DLC-XP/RC should be stored in accordance with those conditions stipulated for Short Term Storage. In addition, a porous bag of 85g (3 oz) silica gel or similar desiccant should be placed beneath the wiring access cover. The cover should be re-installed to seal the desiccant within the enclosure. The three conduit connections must be tightly capped.



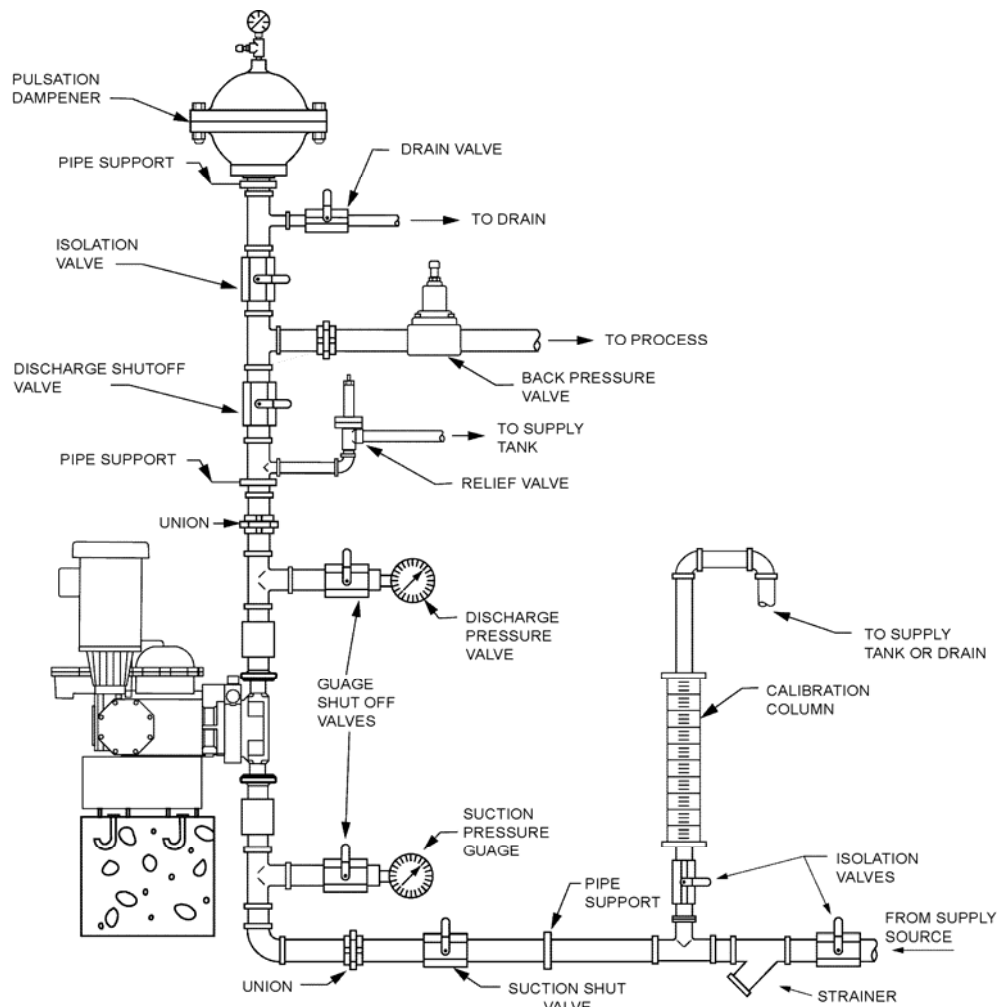
## 5. Installation

### 5.1 Location

**IMPORTANT!** Review the **Safety** section prior to installing the DLC-XP/RC. This section contains important information required to properly install and operate the equipment in an industrial environment.

The site selected for the installation of your DLC-XP/RC is largely dependent on that of the PULSAR metering pump. Review the PULSAR Installation Operation Maintenance Instruction Manual provided with your PULSAR metering pump. It details system related issues that are important to proper operation of the PULSAR metering pump.

Your DLC-XP/RC with the NEMA-7 option consists of 2 main components: the DLC-XP is a pump mounted actuator for installation in hazardous environments, the DLC-RC is the controller that supervises the actuator (DLC-XP). The DLC-RC should be mounted in an area where the operator has access to the front of the unit and a clear view of the display panel and keyboard. It must be mounted within 305m (1000ft) of the DLC-XP. Avoid locations where both the DLC-XP/RC would be subjected to extreme cold or heat. Note the following warning statement. The installation of this device should comply with national, state and local codes.



*Figure 1. Typical Installation.*



**AVOID LOCATIONS WHERE THE DLC-XP/RC WOULD BE SUBJECTED TO EXTREME COLD OR HEAT [LESS THAN -18° CELSIUS (0° FAHRENHEIT) OR GREATER THAN 40° CELSIUS (104° FAHRENHEIT)] OR DIRECT SUNLIGHT. FAILURE TO OBSERVE THIS WARNING COULD DAMAGE THE DLC-XP/RC AND VOID ITS WARRANTY.**

## 5.2 Installation Notes

1. The DLC-RC is a microprocessor based controller that uses static sensitive CMOS components. Do not make any electrical connections (high or low voltage) without adequately grounding the DLC-RC and the worker to eliminate an electro-static charge between the two. A conductive wrist strap worn by the worker and attached to the DLC-RC enclosure is adequate to satisfy this requirement.
2. Calibration is an important element of successful DLC-XP/RC operation, the permanent installation of a calibration column as shown in *Figure 1* is strongly recommended.
3. Conduit connections can carry fluids and vapors into the DLC-XP/RC causing damage and void of warranty. Care should be taken when installing conduit to protect against fluid/vapor entry. Sealed fittings within 18 inches are required for all connections to the DLC-XP.
4. **The upper enclosure cover of the DLC-XP pump-mounted control unit must be securely and properly fastened to ensure compliance with hazardous area regulations. See Section 6.1.2 for the proper procedure.**

### 5.2.1 Electrical Wiring

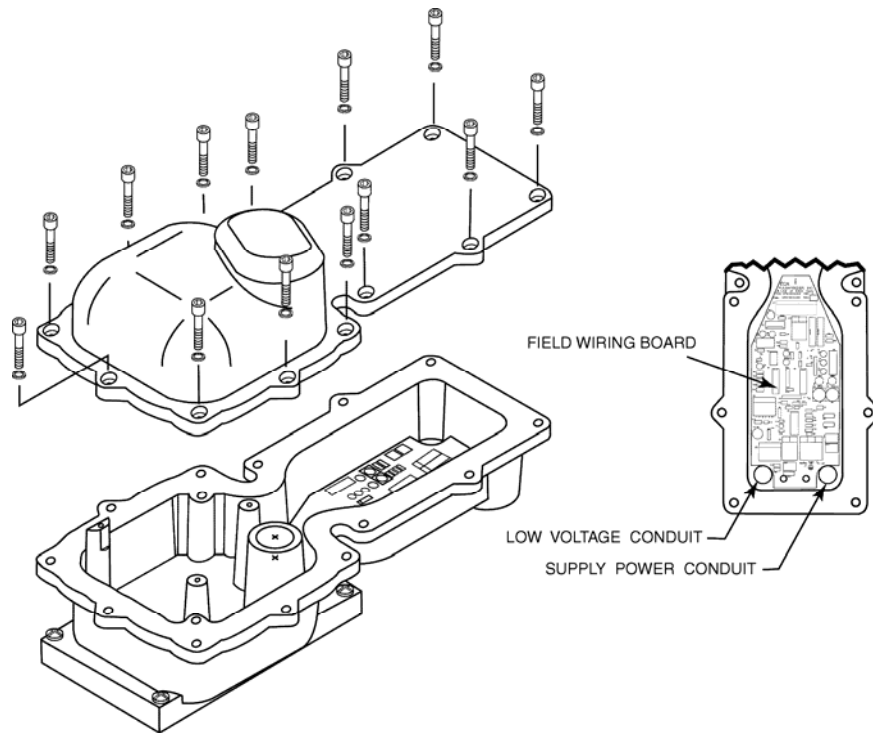
The DLC-XP/RC has many advanced features that may make wiring the unit appear complicated. Wiring is actually very simple -- a minimum of three high voltage and 14 low voltages connections are all that is required to take advantage of a majority of the DLC-XP/RC's features. It is highly recommended that you take a step-by-step approach to wiring and confirming proper DLC-XP/RC operation:

1. Make the (10) low voltage control connections. These allow the DLC-RC to communicate with the DLC-XP.
2. Make the high voltage connections. These will allow you to operate the DLC-XP/RC and attached PULSAR pump. Power-up and test the DLC-XP/RC to confirm the connections and check for proper operation.
3. Decide which low voltage Inputs (e.g., 4-20mA in) will be used and make those connections. Again, power-up and test these connections.
4. Decide which low voltage Outputs (e.g., 4-20mA out) will be used and make those connections. Again, perform the power-up and test cycle.

Refer to *Section 6 – Start Up Instructions* for details on how to perform the power-up tests.

## 5.3 Getting Started

The field wiring terminals of the DLC-XP are accessed by removing the its cover. Remove the 13 retaining screws (Phillips head screw driver required). Refer to **Figure 2**. The field wiring terminals of the DLC-RC are openly visible on the chassis.



*Figure 2 – Accessing the Field Wiring board*



**TIP**

The DLC-XP cover has the Serial Number Tag on it. Please keep the cover with the DLC-XP from which it was removed. The DLC-XP is marked internally with the Serial Number. The internal marking will be used for warranty claims.

The DLC-XP and DLC-RC Field Wiring Boards (see Figure 3) contains wiring blocks for making all of the electrical connections.

Keep careful track of the hardware and o-ring used to secure and seal the upper cover of the control unit. The upper enclosure cover of the DLC-XP pump-mounted control unit must be securely and properly fastened to ensure compliance with hazardous area regulations. See **Section 6.1.2** for the proper procedure.

### 5.3.1 Finding your way around the DLC-XP and DLC-RC Field Wiring Boards.

The electrical connections are segregated on the Field Wiring Boards. On the DLC-XP, the High Voltage connections are near the conduit ports, the low voltage connections are furthest away from them. On the DLC-RC, the high voltage connections are on the right half of the board while the low voltage connections are on the left. Refer to the Field Wiring Board map in **Figure 3** for specific connection and fuse locations.

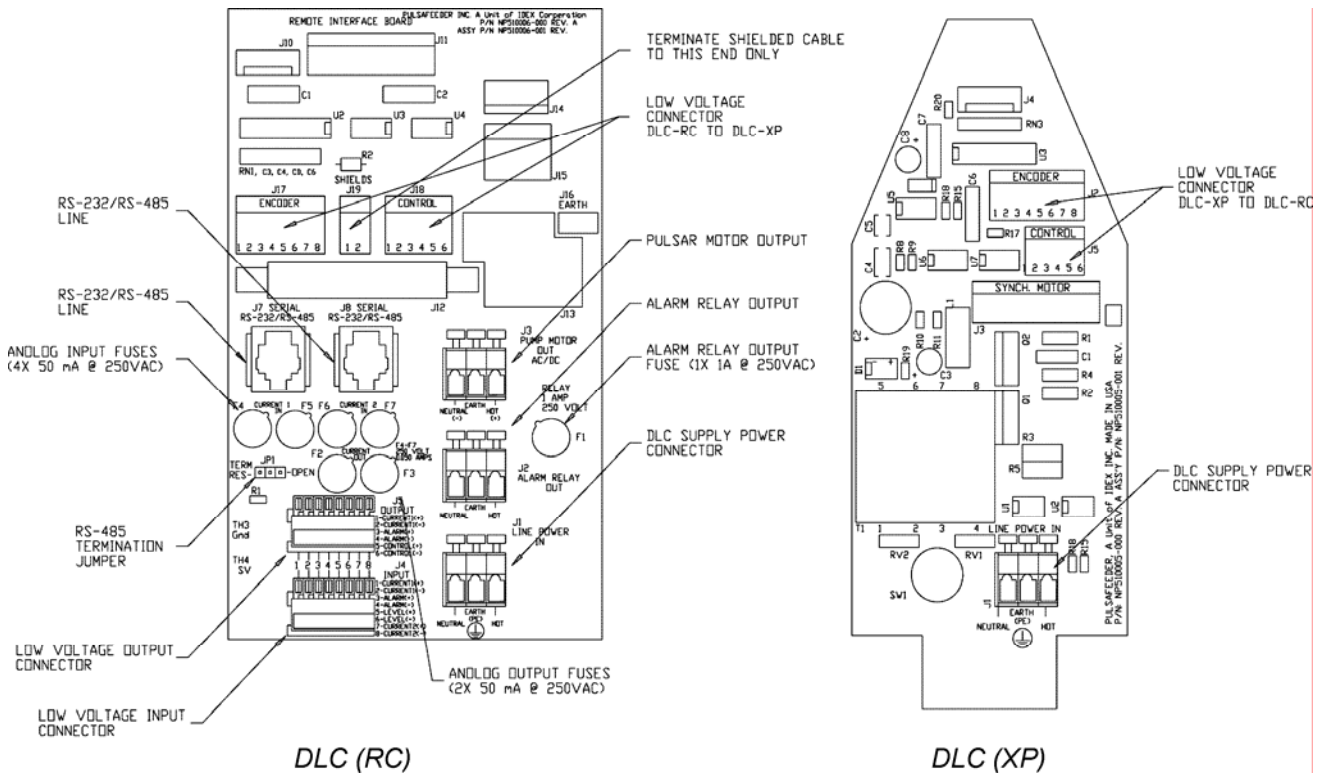


Figure 3. Field Wiring Board Map.

## 5.4 Control Connections

The DLC-RC is attached to the DLC-XP through one 10 conductor shielded cable. This cable transmits the encoder information from the DLC-XP to the DLC-RC -- allowing the DLC-RC to know the position of the stroke adjustment shaft at all times. Additionally this cable transmits the synchronous motor control and power signals from the DLC-RC to the DLC-XP. This allows the DLC-RC to change the position of the stroke adjustment shaft. Care should be taken to ensure that the control connections are made properly. Failure to do so will result in unpredictable operation.



**The DLC-XP to DLC-RC separation distance should be no more than 1220m (4000 ft). The control wiring must not be routed in a conduit that also contains power conductors, as this will cause electrical interference and result in erratic operation. Separate conduits must be used for high voltage and low voltage circuits.**

### 5.4.1 Control

Use Belden 1422A (5 Pair), 24 AWG, 7X32 strand, NEC CM, UL 2919, 30V, 80C, shielded or equivalent.

1. Connect the 4 encoder lines from the DLC-RC J17 terminal block to the DLC-XP J2 terminal block.
2. Connect the 6 control lines from the DLC-RC J18 terminal block to the DLC-XP J5 terminal block.

The shields for both cables should be terminated at the DLC-RC J19 only. The wiring is straight through -- connect position 1 on J17 to position 1 on J2 and position 1 on J18 to position 1 on J5. Refer to *Figure 4*.



**TERMINATE THE CONTROL SHIELD AT THE DLC-RC END ONLY! TERMINATING THE SHIELD AT BOTH THE DLC-RC AND DLC-XP WILL POTENTIALLY CAUSE A GROUND LOOP RESULTING IN UNPREDICTABLE OPERATION AND/OR FAILURE OF THE UNIT THAT IS NOT COVERED BY THE WARRANTY.**



**Wire the control connection carefully. Double check wire order (color codes) before proceeding. Double check all connections to confirm good electrical contact between the terminal block clamp and bare wire. Make sure the clamp is on the wire, not the insulation. Insure that bare wire is not frayed and does not rise above dividers.**

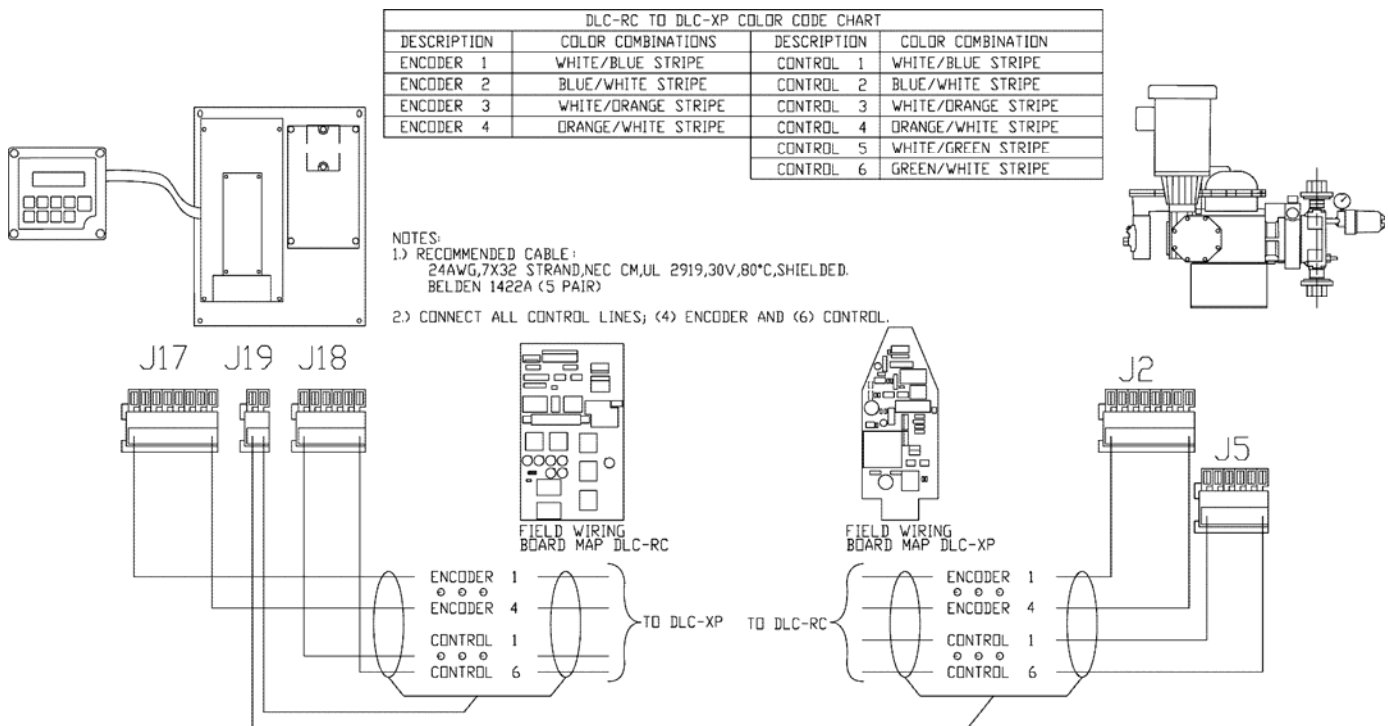


Figure 4. Control Connections

## 5.5 High Voltage Connections

There is only one high voltage connection to be made on the DLC-XP: the supply power (J1). On the DLC-RC, there are only three high voltage connections: the supply power (J1), the PULSAR motor starter relay load (J3), and the Alarm Relay Load (J2). Only the supply power and PULSAR motor starter relay load connections are required. Refer to **Figure 5** for connection location.

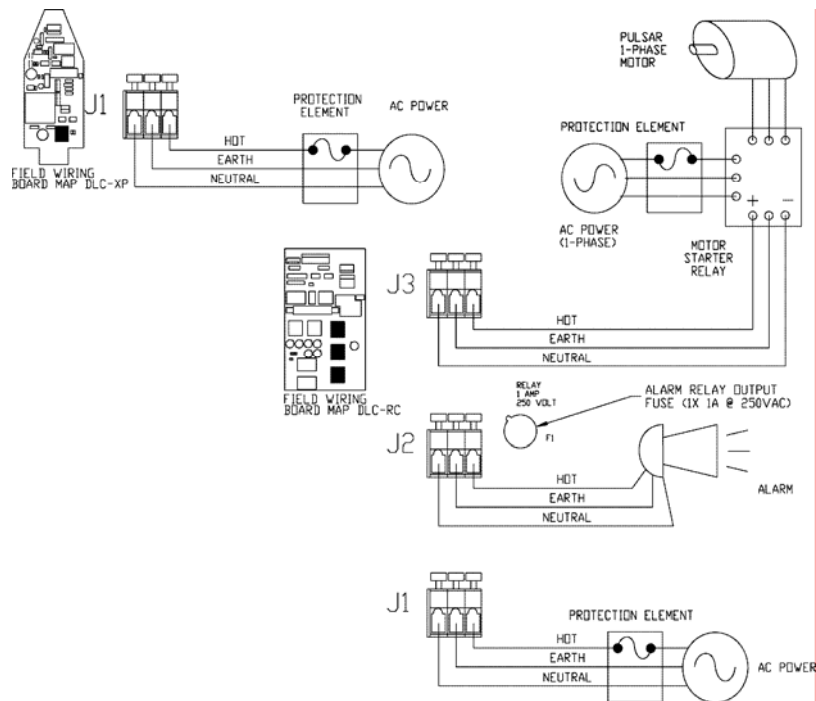


Figure 5. High Voltage Connections

## 5.5.1 Supply Power



The DLC-RC requires one connection to an external power source. It uses this same connection to power its own supply, the motor starter relay (external) and the alarm relay output. The user must be mindful of these external loads when sizing the branch circuit.

The DLC-RC power supply and attached PULSAR motor starter relay (external) are not fuse protected. The user is responsible for correctly sizing the protection element (i.e., fuse or circuit breaker at the distribution panel). Use the work sheet in Table 2 for correctly sizing the branch protection element.

115VAC +/- 10% 50/60Hz		230VAC +/- 10% 50/60Hz	
Device	Current Requirement(Amp)	Device	Current Requirement (Amp)
DLC-RC	1A (1A Max.)	DLC-RC	.5A (.5A Max.)
Motor Relay*	+ (8A Max.)	Motor Relay*	+ (4A Max.)
Alarm Relay*	+ (1A Max.)	Alarm Relay*	+ (1A Max.)
<b>Total DLC-RC**</b>	=	<b>Total-DLC-RC **</b>	=
<b>Total DLC-XP**</b>	1A (1A Max.)	<b>Total DLC-XP**</b>	.5A (.5A Max.)
<p>* In-rush current requirements should be considered. All values RMS.</p> <p>** Calculation is for guideline purposes only. User must consult local electrical codes when sizing branch circuits. Protection must not exceed 10Amps RMS at 115VAC or 5.5Amps RMS at 230VAC.</p>			

Table 2: Branch Circuit Protective Element Sizing Worksheet.

The DLC-RC with an attached pump motor relay and alarm load, should be connected to its own branch circuit. Size the supply wire and protective element according to local code requirements. Use 14 AWG, 105° C insulation wire or better. Attach the supply to the J1 terminal block labeled 'LINE POWER IN'. Make 3 connections: Neutral, Earth (ground) and Hot as labeled.

The DLC-XP should also be connected to its own branch circuit. Size the supply wire and protective element according to local code requirements. Use 14 AWG, 105° C insulation wire or better. Attach the supply to the J1 terminal block labeled 'LINE POWER IN'. Make 3 connections: Neutral, Earth (ground) and Hot as labeled.

The operating voltage and frequency of the DLC-XP are factory configured -- an internal motor/capacitor and power supply are sized according to voltage and frequency. Attempting to operate DLC-XP outside of rating will result in damage to the unit that is not covered by the warranty.

The operating voltage and frequency of the DLC-RC are also factory configured. If the power supplied to the DLC-RC does not match the factory configuration, it will display an {OVER VOLTAGE} diagnostic message on power-up. This is possible because the microprocessor and display are powered by a switching power supply. It detects the incoming power and self-regulates its output. This power supply is protected by a 7.4 Joule surge suppression device. The microprocessor will not operate the DLC-XP, until the voltage problem is corrected.



**High Voltage circuits (e.g., branch) should be run in separate conduit. Do not combine High Voltage (i.e., greater than 100VAC) lines and Low Voltage (i.e., less than 28VDC) lines in a common conduit!**

## 5.5.2 PULSAR Motor Starter Relay (DLC-RC)

Connect the pump motor starter relay to the J3 terminal block on the DLC-RC labeled PUMP 'MOTOR OUT AC/DC.' Use 14 AWG, 105° C insulation wire size or larger. The pump motor starter relay must be wired to operate at the DLC-RC supply voltage (i.e., if the power supplied to J1 is 115VAC 60Hz, then the motor must operate on 115VAC at 60Hz).



**THE DLC-RC USES SOLID-STATE RELAYS FOR IT'S HIGH VOLTAGE OUTPUTS (I.E., MOTOR AND ALARM). IN THE 'OFF' STATE, THESE DEVICES TYPICALLY LEAK 20-30mA OF CURRENT AT THE SUPPLY VOLTAGE! THE SUPPLY POWER MUST BE DISCONNECTED AT THE MAIN BEFORE WORKING ON ELECTRICAL CONNECTIONS.**

Wire the PULSAR motor to the motor starter in accordance with the starter manufacturer's instructions. Alternately, the three-phase logic output may be used for most solid-state relay control devices. See the Low Voltage Output, Three-Phase Solid State Relay sub-title in this Section for more information. Double check all connections to confirm good electrical contact between the terminal block clamp and bare wire. Make sure the clamp is on the wire, not the insulation. Insure that bare wire is not frayed and does not rise above dividers.

### 5.5.3 Alarm Relay (DLC-RC)

The Alarm Relay is an output that is configured by the user. Please refer to the section 7-General Operation for specific instructions on how to activate the Alarm Relay. The Alarm Relay Load must not exceed 1Amp at rated voltage. Connect the Alarm load to the J2 terminal block labeled 'ALARM RELAY OUT.' Use 22 AWG wire size or larger. Make three connections: Neutral, Earth (ground) and Hot as labeled.

## 5.6 Low Voltage Input Connections

There are two types of Low Voltage inputs: Analog (e.g., 4-20mA) and Dry Contact. The Low Voltage Input connection block is labeled J4 'INPUT' (see Figure 6). It contains four-pairs of inputs: Analog Input, Alarm, Drum and Second Analog Input.



**THE DRY CONTACT INPUTS ARE SELF-POWERED. SUPPLY ONLY A MECHANICAL SWITCH CLOSURE TO ACTIVATE. DO NOT ATTACH EXTERNALLY POWERED CIRCUITRY.**

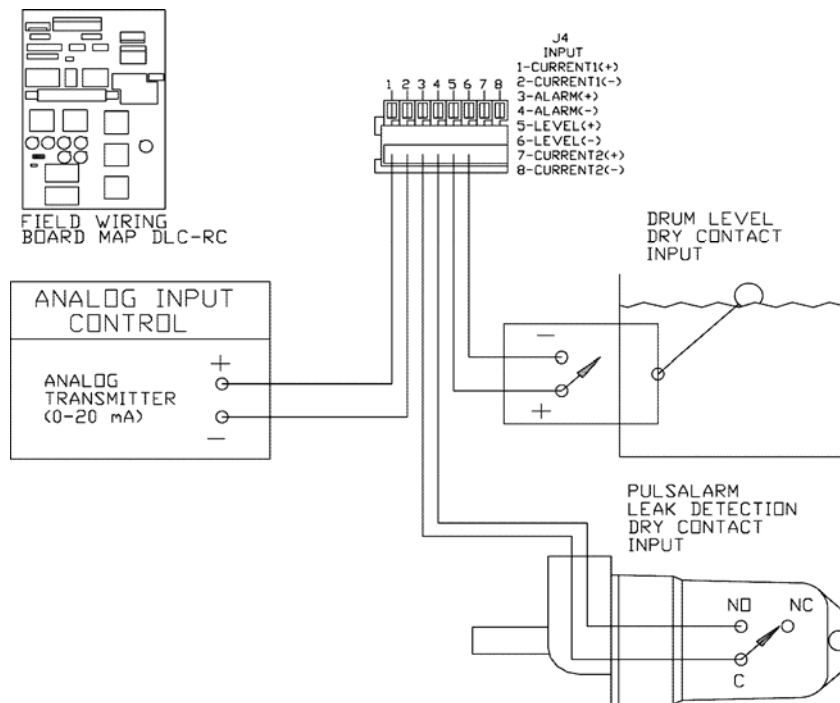


Figure 6. Low Voltage Input.



### 5.6.1 Analog Input (DLC-RC)

The Analog Input is used for remote control of the PULSAR flow. The input accepts current inputs anywhere in the range of 0-25mA (e.g., 4-20mA) provided the 'span', (the difference between the High and Low value), is greater than 2mA. Voltage signals in the 0-5 volt range are accepted but displayed as current during Analog Input calibration.

Split-ranging, reverse acting, and ratio control are accomplished in the calibration routine. No hardware adjustments are required. The channel is surge protected and fused for over-current protection. The device is designed to avoid damage in the event high voltage is inadvertently applied.

Attach the analog signal generated by an external device (e.g., PLC) to the connection points labeled '1-CURRENT1(+)' and '2-CURRENT1(-)' on the J4 terminal block labeled 'INPUT' (refer to **Figure 6**). Attach the Positive lead to position 1 and the Negative lead to position 2. Position indicators are printed on the circuit board above the terminal. The DLC-RC will provide approximately 200 ohms of resistance to a current loop. The Analog Input is isolated from all other inputs, outputs and earth ground. Follow the instructions in the **Section 7 – General Operation** for Analog Input software set-up.

### 5.6.2 Leak Detection Input (DLC-RC)

The Leak Detection Dry Contact Input is designed to operate with the PULSAlarm leak detection option. It is software configurable to generate an alarm, activate the alarm relay and/or shut down the PULSAR motor. The input is internally powered -- only a mechanical switch closure is required for activation. Attach one side of the switching device to the position labeled '3-ALARM(+)' and the other side to the position labeled '4-ALARM(-)' of connector J4-INPUT (see Figure 6). A resistance of 15K ohms or less is required across the two connections for proper detection. Follow the instructions in the section 7-General Operation for Alarm Input (Leak Detection) software set-up.

### 5.6.3 Drum Level Input (DLC-RC)

The Drum Level Dry Contact Input is designed to monitor a single-point drum level sensor and generate an alarm, activate the alarm relay and/or shut down the PULSAR motor. The input is internally powered, only a mechanical switch closure is required for activation. Attach one side of the switching device to the position labeled '5-LEVEL(+)' and the other side to the position labeled '6-LEVEL(-)' of connector J4-INPUT (see Figure 6). A resistance of 15K ohms or less across the two terminals is required for proper detection.

This input is also commonly used as a “RUN/STOP” input and can be connected to any appropriate switching device or PLC output. Follow the instructions in the **Section 7-General Operation** for Drum Level Input software set-up.

### 5.6.4 Second Analog Input (DLC-RC)

The Second Analog Input is reserved for future use. Make no connection here.

## 5.7 Low Voltage Output Connections

The DLC-XP control offers one Analog (e.g., 4-20mA) output, and two Transistor-based digital outputs. The Low Voltage Output connection block is labeled J5 'OUTPUT' (refer to **Figure 7**). It contains three-pairs of outputs: Analog, Alarm and Motor Control Signal.



**The Transistor based Dry Contact output is optically isolated. It is not self-powered to achieve total isolation. The external device must supply and detect a return voltage level. The maximum voltage capability of these outputs is 24 VDC.**

### 5.7.1 Analog Output (DLC-RC)

The Analog Output Channel follows the actual stroke length position. It is calibrated to source current in the 0 to 20mA range (e.g., 4-20mA). Refer to the **Section 7 – General Operation: Calibration** for further details.

The Analog Output is used to control slave devices (e.g., DLC's, ELMA's, PULSAMATICs, etc.) or to fulfill closed loop system requirements. Attach the connection points labeled '1-CURRENT(+)' and '2-CURRENT(-)' on connector J5-OUTPUT (see Figure 7) to the external device. Attach the Positive lead to position 1 and the Negative lead to position 2. The analog output will drive against a maximum load of approximately 700 ohms. The Analog Output is isolated from all other inputs, outputs, and earth ground. Refer to the instructions in **Section 7 – General Operation: Calibration for Analog Output Calibration**.

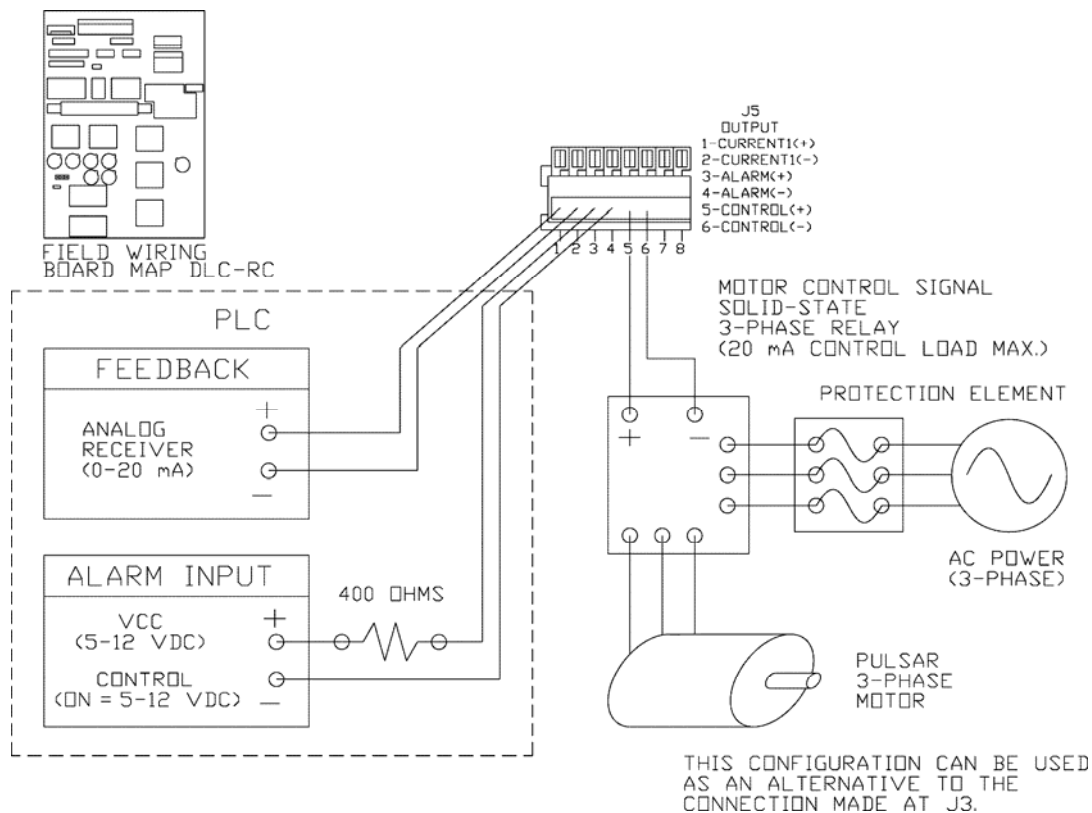


Figure 7. Low Voltage Output.

## 5.7.2 Alarm and Motor Status Outputs (DLC-RC)

The Alarm and Status outputs are solid state transistor type. Logic HIGH indicates an ON condition while logic LOW indicates an OFF condition. They are commonly used to indicate an alarm status and run status to external control equipment (i.e., PLC, PC or other digital controllers). These outputs are limited to switching a maximum of 24 VDC. Refer to **Figures 7 and 8**.

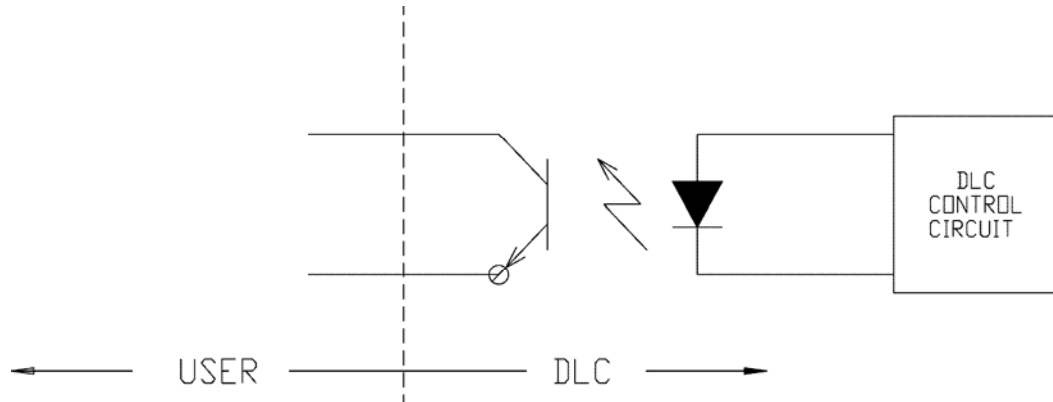


Figure 8. Schematic, Transistor based Alarm Output.



**VCC (+5VDC) and Ground are provided on terminals 7 and 8 of connector J5. A 250 ohm resistor from terminal '7-VCC' to terminal '3-ALARM(+)' will cause a +5VDC signal to appear between terminals '4-ALARM(-)' and 8-DCGND' when the alarm output is activated. This technique is only recommended if the input on the external device is isolated from all other inputs, outputs and grounds.**

An opto-coupler is used to achieve total isolation of this device. As such, the external control equipment must generate the supply on the positive output and detect the return of that signal when the output is activated by the DLC. In a typical application, attach the terminal labeled '3-ALARM(+)' -- the collector terminal -- to the external equipment's logic supply (refer to *Figure 8*). Connect the terminal labeled '4-ALARM(-)' -- the emitter terminal -- to the positive input of the equipment. The negative input of the equipment should be connected to its isolated ground. A series resistance of 400 ohms is recommended especially when a sinking current (e.g., a photo-diode of an opto-isolator). The Alarm output cannot be directly configured in software. It follows the Alarm Relay output. Similarly, the status output is available at terminals 5 (+) and 6 (-) and it's status will follow the operation of the pump motor.

## 5.8 Fuse Replacement

Although Fuse replacement is not a part of normal installation, it is often likely that fuse failure will result from improper wiring. The DLC-RC uses a total of 7 user replaceable fuses: 1 for the alarm relay output, 2 for each of the Analog Input and Output Channels. Table 3 details fuse replacement information:

Designator	Function	Rating	Manufacture P/N	Pulsafeeder P/N
F1	Alarm Relay	1A@250VAC	WK4048-ND	NP5300026-000
F2-7	Analog Current I/O	50mA @ 250VAC	WK3022-ND	NP5300027-000

Table 3: Replacement Fuse Information

Figure 11 details the location of these fuses on the Field Wiring Board.

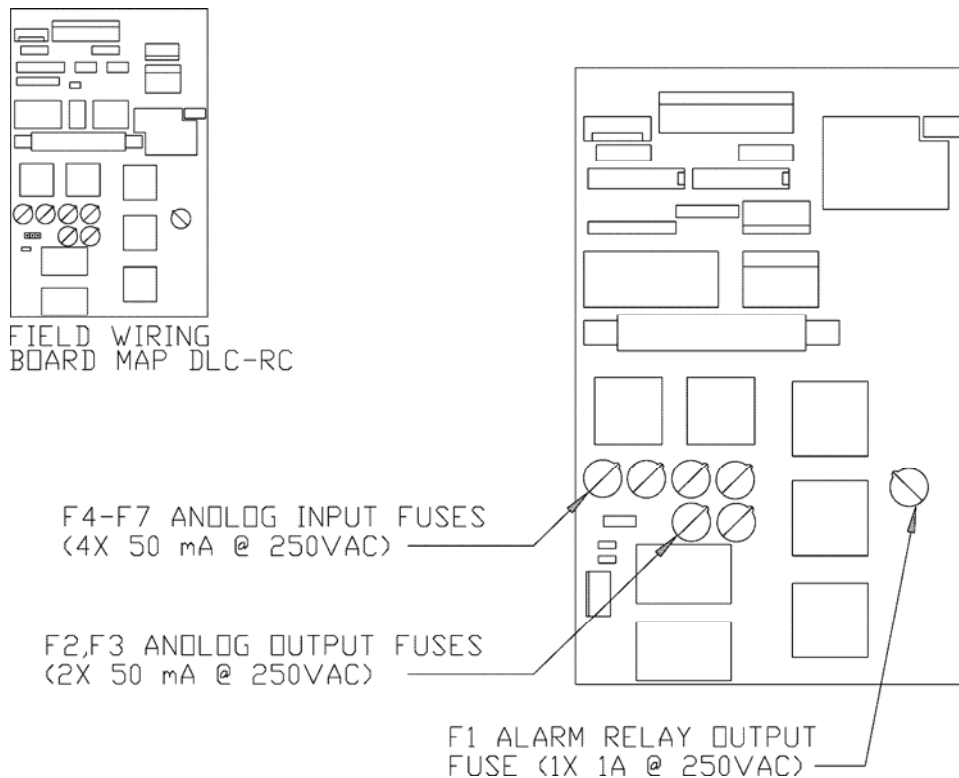


Figure 11. Fuse Location.

The Internal DLC-RC power supply is fused at 2Amps. This fuse is not user serviceable. The DLC-XP power supply is not fuse protected. The user is responsible for supplying this element in a non-hazardous location. The DLC-XP Stroke Length Adjustment Shaft Synchronous Motor is inherently protected. It can operate continuously in a locked rotor state. The DLC-RC also monitors this motor's duty cycle to maintain a 50% balance between ON and OFF times. The isolation elements of the Current Inputs and Outputs, and the Motor Transistor Output are protected by self-resetting current limit devices. These components are not user serviceable.

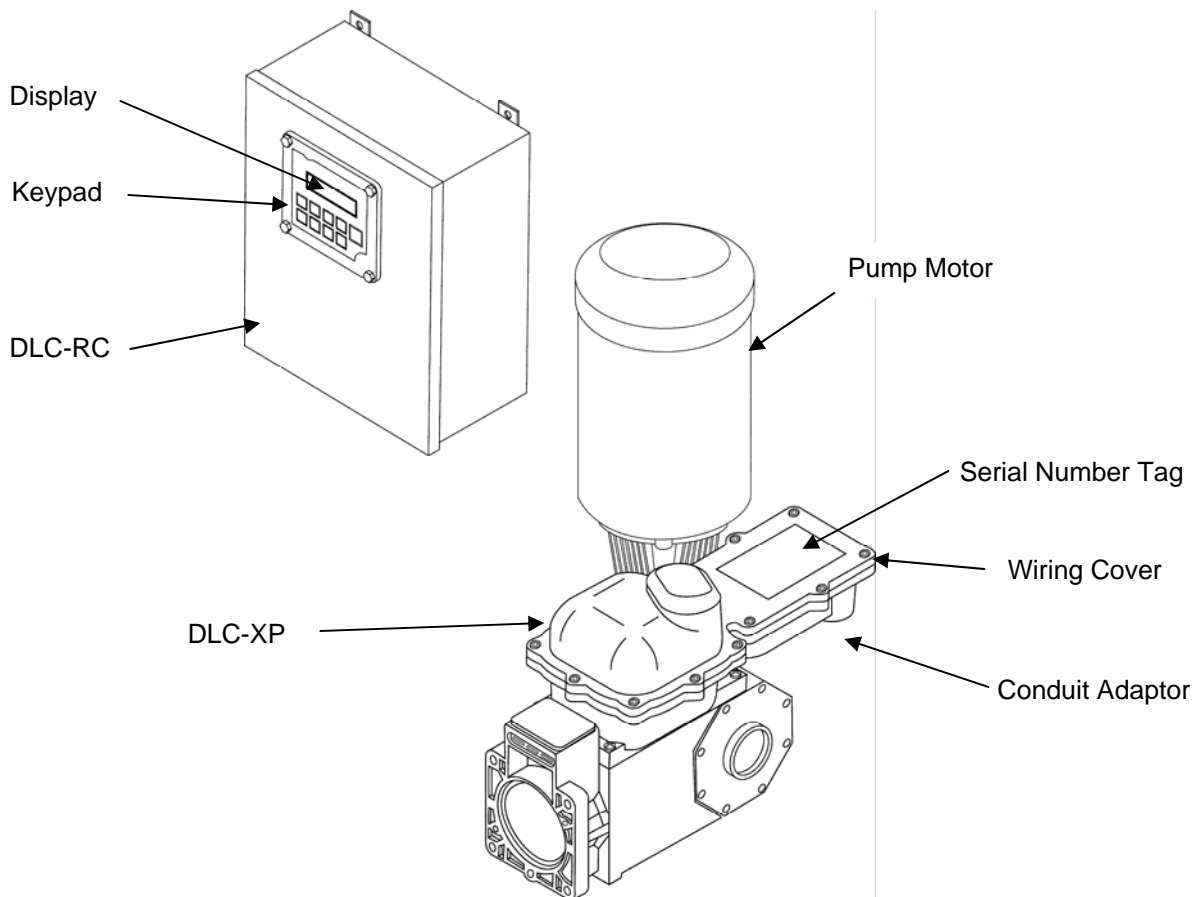
## 6. Start Up Instructions

### 6.1 Overview

Once all electrical connections have been made, your DLC-XP/RC is ready for Start-up. This can be completed in 9 simple steps.



**WHEN POWER IS SUPPLIED TO THE UNIT, LINE VOLTAGE IS PRESENT ON THE FIELD WIRING BOARDS OF BOTH THE DLC-XP AND DLC-RC EVEN WHEN THE MOTOR IS OFF.**



*Figure 12 – Key DLC-XP/RC start-up elements*



**DURING START-UP, IT IS NECESSARY TO START THE PUMP MOTOR. THIS WILL CAUSE FLUID TO DISCHARGE FROM THE PUMP. THE USER IS RESPONSIBLE FOR SAFELY DIVERTING FLOW FROM THE PUMP DURING START-UP AND CALIBRATION.**

### 6.1.1 User Interface Familiarization.

There are four key elements that will be useful in starting-up the DLC: the Display, the Keypad, the DLC-XP and the Pump Motor. Refer to **Figure 12** to familiarize yourself with the location of these items before proceeding.

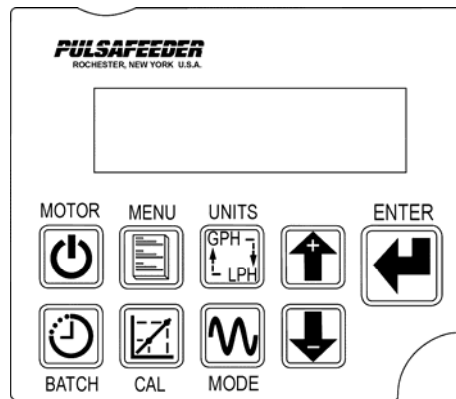


Figure 13 – Keypad

#### 6.1.1.1 Display

This is a 2 line by 16 character alpha-numeric Liquid Crystal Display (LCD) located above the keypad. It is back-lit with a yellow-green light source for easy viewing in dark areas. Its contrast can be adjusted by using the keypad.

#### 6.1.1.2 Keypad

The Keypad is a sealed 9-button membrane style input device. It is easy to use and will guide you quickly to specific functions. Please take a few moments to familiarize yourself with the function of each key before starting (also, see Figure 13):



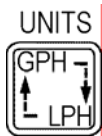
MOTOR

Press this key to Start the PULSAR motor or place it in stand-by.



MENU

Press this key to access the Configuration Menu. Press the ARROW keys to scroll through the Configuration Menu Items. Press MENU a second time to exit the Configuration menu to the current operating status mode (e.g., MANUAL MODE).



UNITS

Press this key to cycle to the next unit type whenever a unit is displayed at the operating status mode (e.g., MANUAL MODE).



These keys are used to change values currently displayed on screen. Use the [DOWN] arrow to decrease the value and the [UP] arrow to increase it. Pressing both [UP] and [DOWN] arrows simultaneously performs special editing and bypass functions. This is described further in the section 6-General Operation.



ENTER

Use this key to accept a flashing value or parameter and proceed to the next sub-menu screen.



This key is used to activate the [BATCH] processing menu.



Press the [CAL] key to activate the Calibration menu for Flow and Analog Signals.



The [MODE] key is used to change the operating mode of the DLC. For example, press once to change from MANUAL to ANALOG. Press a second time to change from ANALOG to MANUAL.

#### 6.1.1.3 Actuator (DLC-XP):

The Actuator or DLC-XP is mechanically attached to the PULSAR. It drives the stroke length adjustment mechanism. Proper operation of this device is confirmed by watching the PULSAR piston and return spring move through the PULSAR's diagnostic viewport (refer to *Bulletin #: PMP-IOM-96*).



**THE DLC-XP SHOULD NEVER BE POWERED OR ACTIVATED WITHOUT ITS COVER IN A HAZARDOUS ENVIRONMENT.**



**DURING A ZERO CALIBRATION THE DLC-XP IS SEARCHING FOR A HARD MECHANICAL STOP. ANY MANUAL INTERVENTION COULD CAUSE THE DLC-XP TO INCORRECTLY DETECT THIS STOP. THIS WILL RESULT IN AN IMPROPER CALIBRATION.**



**You may notice that when adjusting from a lower to a higher value (e.g., 10% to 20%) the DLC-XP appears to 'over-shoot' its destination and reverse direction for approximately 1/16 of a revolution. This behavior is normal. The DLC-XP always approaches a new position from the same direction to eliminate backlash in the stroke adjustment mechanism.**

#### 6.1.1.4 PULSAR Motor:

The PULSAR drive motor and corresponding motor starter are excellent indicators that the DLC-RC is functioning properly. This can be witnessed by observing the motor fan turning or the motor starter pulling in.

### 6.1.2 Check Wiring and Close Covers

Double check all of your electrical connections. Pay attention to the polarity of all inputs and outputs -- both low and high voltage. Additionally, insure that all clamp style terminals are clamping onto the bare conductor, not on its insulation.

Clean the mating flange surface on the cover and base with de-greaser and a clean cloth. Inspect the o-ring in the cover to assure it is properly installed in the receiving groove. Replace the DLC-XP cover. Be careful to properly align the cover on its alignment pins. Do not force the cover as difficulty in assembly indicates mis-alignment. Hand tighten the 13 retaining screws. Check the cover joint using a 0.0015in (0.038mm) feeler gage. Clearance should be less than 0.0015in (0.038mm) such that the feeler gage will not enter the joint more than 0.125in (3.2mm) at any point. If necessary, torque the cover bolts to a maximum of 100in-lb (11.3N-m).

### 6.1.3 Confirm Correct Incoming Power

Double check that the DLC-XP cover is on and tightened down. Apply power to the DLC-XP first. Its proper operation will be confirmed when power is applied to the DLC-RC. When shutting down the DLC, turn the power to the DLC-XP off after power has been removed from the DLC-RC.

Applying power to the DLC-RC will cause its display back-lighting to 'glow' with a yellow-green light. The presence of this back-lighting is an excellent indication that the DLC-RC's incoming power has been wired successfully and voltage is present. Characters may or may not appear on the display. This is normal and will be covered in the next Step.



**WITHOUT PRIOR OPERATING KNOWLEDGE, IT IS IMPOSSIBLE TO TELL WHETHER OR NOT THE PULSAR MOTOR WILL RUN WHEN POWER IS APPLIED TO THE DLC-RC. THE USER IS RESPONSIBLE FOR TAKING THE NECESSARY STEPS TO ENSURE THAT ALL ASPECTS OF SAFETY HAVE BEEN CONSIDERED (E.G., ELECTRICAL, HYDRAULIC, ETC.). IF IN DOUBT, DISCONNECT THE PULSAR MOTOR STARTER FROM J3 PRIOR TO APPLYING POWER.**



The DLC-RC detects any adjustments made to the stroke adjustment mechanism (DLC-XP) while its power is off. If it detects that the position has changed, it will perform a zero calibration when the motor is started. This action is normal.

Turn on power at the main. If the DLC-RC's in-coming power is connected correctly, the back-lighting on the DLC's display will illuminate (depending on lighting conditions, it may be necessary to shade the display to confirm illumination). If the display is not illuminating, first check the line voltage with a volt meter. If the voltage is correct, return to the Section 5-Installation: High Voltage Connections. Otherwise, proceed with the next step.

### 6.1.4 Confirm the display and keypad are functioning properly



The example display messages are shown in English for demonstration purposes. If an alternate language has been set, the text will appear as a translation of the English version.

Now that you have confirmed that the DLC-RC is receiving power, it is necessary to confirm that the display and keypad are functioning properly. On normal power-up, the {**SELF-TEST**} display will appear for approximately 5 seconds. After that time, the display may appear with a message similar to any of those shown in *Figure 14*.

SELF-TEST 1.23.3	or	TURN MOTOR ON CALIBRATING ZERO	or	PLEASE WAIT CALIBRATING ZERO
TURN MOTOR ON TESTING ENCODER	or	PLEASE WAIT TESTING ENCODER	or	MOTOR STOPPED
10.0% MANUAL MODE	or	BATCH#1 RUNNING 10.0%	or	BATCH#1 PENDING HH:MM MM/DD/YY
DLC-XP CHECK POWER	or	PLEASE WAIT CHECK POWER	or	PLEASE WAIT PLEASE WAIT

*Figure 14. Common Power-On Displays.*



At this time, the actual message is un-important, the characters should be visible and form a reasonable message.

If the display is blank (no-characters) then the display contrast must be adjusted. This can be accomplished by pressing and holding [MENU] while simultaneously pressing [UP]. This will darken the display. Be patient! You may have to hold both keys down for as long as 30 seconds before the characters will become visible. If the display is too dark, press [MENU] and [DOWN] simultaneously to decrease (lighten) the contrast. Once the contrast is properly adjusted, check the message displayed. If it does not look similar to one of those shown in *Figure 14*, proceed directly to Step #5 to perform a Factory Re-initialization on your DLC-RC.

The keypad can be tested by depressing each key separately. Most, but not all keys will cause the text on the display to change. Do not be alarmed if a single key does not invoke a change to the display. This is normal. Different keys become active/de-active depending on the current operating mode. There are a number of functions that the DLC-XP/RC performs (e.g., zero calibration) where the keypad has no effect. In any case, at least one key on the keypad should cause the text on the display to change. If this is not the case, refer to *Section 11 – Trouble Shooting*. Skip to Section 6.1.6.

### 6.1.5 Performing a Factory Re-initialization.



**When Re-initializing your DLC-RC, all of the system settings will be overwritten by original factory default settings. The controller must be re-configured to your specifications (e.g., re-calibrated).**

If your DLC-RC appears to be functioning properly -- the display is similar to one of those shown in *Figure 14* -- skip to Section 6.1.6.

A Factory Re-initialization restores all factory defaults to the DLC-RC's memory.

A Factory Re-initialization is typically not required. It should be performed only if the user has reason to believe that the internal DLC-RC memory has become corrupted. A number of factors could cause this including: long-term storage, dis-regard of electrostatic precautions (refer to *Section 2 – Safety*) during installation, improper wiring, voltage surges, etc. The condition usually manifests itself with inconsistent or erratic operation -- often associated with characters on the display. Depending on the state of your DLC-RC, use one of the following:

### 6.1.6 Start-up Factory Re-initialization:

If the user interface is not functioning properly (e.g., the display is blank or illegible), perform the following:

1. Cycle power (turn it OFF then ON) to the DLC-RC.
2. Within the first 5 seconds of power on, simultaneously depress and hold the [UNITS], [MODE], and [ENTER] keys for approximately 1 second.
3. The display will become blank for approximately 10 seconds while the DLC-RC's memory is restored. The unit should operate normally. Return to Section 6.1.4: Confirm the Display and Keypad are functioning properly.

### 6.1.7 Menu Factory Re-Initialization:

If the user interface is functioning properly, Factory Re-Initialization can be found in the Configure Menu. Perform the following steps:

1. Apply power to the unit. Wait for the {SELF-TEST} display to disappear. The unit should display a standard power on screen (refer to *Figure 13*).
2. Press [MENU]. The display will show the first menu item {DIAGNOSTICS}.
3. Press [DOWN] one time. The {FACTORY DEFAULTS} menu item should appear. If not, continue pressing [DOWN] until it does.
4. Press [ENTER]. The prompt {FACTORY DEFAULTS? NO} is displayed.
5. Press [UP]. The prompt will read {FACTORY DEFAULTS? YES}.
6. Press [ENTER] to accept the {YES} prompt. The prompt {ARE YOU SURE? NO} is displayed.
7. Press [UP]. The prompt will read {ARE YOU SURE? YES}.
8. Press [ENTER] to accept the {YES} prompt.

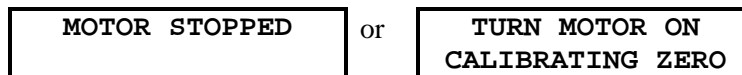
The display will become blank for approximately 5 seconds while the DLC's memory is restored. The unit should operate normally. Return to Section 6.1.4. Confirm the Display and Keypad are functioning properly.

### 6.1.8 Test Pump Motor



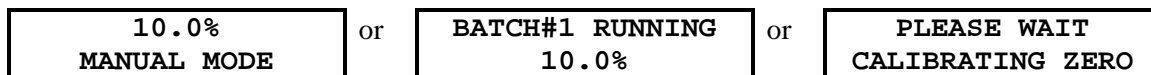
**The Drum Level, PULSAlarm and Signal Loss inputs can be configured to shut the motor down if they are active. If this is the case, a message will appear on the screen indicating the alarming option. You cannot re-start the motor until these inputs have been corrected or the Motor Off option has been de-selected. Please see the section 7-General Operation for further information on configuring these options.**

To test the PULSAR motor connection, press the [MOTOR] key. If the motor is running it should stop and the display should read {MOTOR STOPPED} or {TURN MOTOR ON / CALIBRATING ZERO} as in Figure 15.



*Figure 15. Motor Stopped Display*

If the motor is stopped, press the [MOTOR] key to start it and set the unit in Operating Mode. The display should then read {MANUAL MODE} or {BATCH#X RUNNING} or {PLEASE WAIT / CALIBRATING ZERO} as in Figure 16.

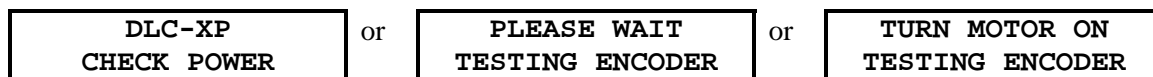


*Figure 16. Operating Mode Display*

If the displays shown in *Figures 15 and 16* appear but the PULSAR motor does not start, return to the Section 5-Installation: High Voltage Connections and check your wiring. If the wiring is correct, refer to Section 11 – Trouble Shooting.

### 6.1.9 Confirm Proper DLC-XP Operation.

To confirm that your DLC-XP is properly wired to your DLC-RC it is necessary to cause the DLC-XP/RC to perform a zero calibration. Quite often when installing a DLC-XP/RC the unit will perform a zero calibration when it is first powered up (refer to *Figure 17*).



*Figure 17. Check Power / Calibrating Zero*

If your DLC-RC is displaying the {Check Power} screen, then you should begin by checking system power.

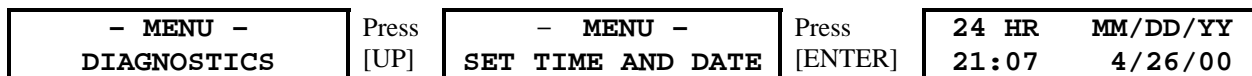
1. Remove the power to the DLC – RC at the source.
2. Check wiring connections from the DLC-XP.
3. Verify that power has been applied to the DLC-XP.
4. Apply power to the DLC – RC.

If your unit is not currently displaying one of the other screens depicted in *Figure 17*, you can force it to do so by pressing: [CAL] and then [ENTER]. This will initiate a flow calibration (calibrating zero is the first step in performing a flow calibration). If the display reads {TURN MOTOR ON/TESTING ENCODER} press [MOTOR] to start the PULSAR motor. The DLC will then attempt to adjust the PULSAR stroke setting to the zero mechanical stop. In this process it will perform a test of the encoder to insure proper encoder operation.

### 6.1.10 Set Time and Date

The clock on your DLC-RC has been activated at the factory, but you must set it to the local time and date of the installation site. Refer to **Section 7 – General Operation: Set Time and Date** for more detailed instructions on how to set the Time and Date information. Time and Date are set in the Configuration Menu. Below is an example that accepts some software default values:

1. From the Current Operating Mode Display, press the [MENU] key. The {-MENU- / DIAGNOSTICS-0} screen will display (follow along with Figure 17).
2. Press [UP] one time. The {-MENU- / SET TIME AND DATE} screen will appear.
3. Press [ENTER]. The date and time screen will appear.
4. Press [ENTER] to accept the 24 Hour time setting.
5. Press [UP] or [DOWN] to adjust the hour value displayed to the local time. Press [ENTER].
6. Press [UP] or [DOWN] to adjust the 10 minute value displayed to the local time. Press [ENTER].
7. Press [UP] or [DOWN] to adjust the 1 minute value displayed to the local time. Press [ENTER] twice (accept the default MM/DD/YY setting).
8. Press [UP] or [DOWN] to adjust the month value displayed to the current month. Press [ENTER].
9. Press [UP] or [DOWN] to adjust the day value displayed to the current day. Press [ENTER].
10. Press [UP] or [DOWN] to adjust the year value displayed to the current year. Press [ENTER] twice (accept the default Daylight Savings NO setting).
11. Press [UP] or [DOWN] to adjust the day of the week to the current day. Press [ENTER] twice. The date and time information has now been set.



*Figure 18. Date and Time Menu*

### 6.1.11 Calibration (1-point).

Your DLC-XP/RC is factory calibrated at rated flow and pressure (1-point). Nevertheless, you should always perform a calibration with the PULSAR DLC-XP/RC installed in your system. In addition, a flow calibration will confirm that the DLC-XP is communicating properly with the DLC-RC. The only item required to calibrate your DLC-XP/RC is a means to measure the output of the pump (i.e., calibration column, graduated cylinder, etc.). The following is a minimal procedure for performing a 1-point calibration. Refer to **Section 7 – General Operation: Calibration, Pump Flow** for more detailed instructions on how to perform a DLC-XP/RC calibration.



**Fluid compressibility will drastically influence the accuracy of a 1-point calibration. The user is advised to perform a multi-point calibration.**

1. Press the [MOTOR] key to start the motor (if the motor is not currently running).
2. Press the [UNITS] key repeatedly until a unit that is consistent with your flow measurement device i.e., calibration column) appears. For Example, if your column reads in Liters then set the display to LPM or LPH. Liters will be used in this example.
3. Press the [CAL] key. The {CALIBRATE / PUMP FLOW} screen is displayed.
4. Press [ENTER]. The {LAST FLOW CAL / 21:32 4/26/00} screen will appear.
5. Press [ENTER]. The {FLOW CALIBRATION / 1-POINT} screen will appear.
6. Press [ENTER]. The {PLEASE WAIT / CALIBRATING ZERO} screen will appear. The DLC-XP will adjust the stroke to the 0% position(\*).
7. The {PLEASE WAIT / 14% 100%} screen will appear. The DLC-XP/RC will adjust the stroke to the 100% position. The PULSAR motor will shut off.
8. The {ENTER TO START/ 100% 1.3642} screen will appear. The value '1.3642' represents the amount of fluid discharged over 60 seconds the last time a calibration was performed at the 100% stroke setting. Record the base reading from your calibration column.
9. Press [ENTER]. The PULSAR motor will Start to run. A timer will display counting down from 60 seconds. After 60 seconds the motor will stop automatically.
10. The {ENTER NEW VALUE / 100% 1.3642} screen will display. Read the calibration column and enter the new value one position at a time using the [UP] and [DOWN] to change an individual position. Press [ENTER] move the cursor to the next value.
11. Pressing [ENTER] on the last value will cause the {CONFIRM CHANGE? / YES} screen to appear. Press [ENTER] to accept. Your 1-point calibration is now complete.

(\*) If during the {PLEASE WAIT / CALIBRATING ZERO} display (step 6) you obtain the following message: {ENCODER ERROR ## / PRESS ENTER} then one of two conditions is causing this error: 1) the DLC-XP is not powered or 2) the control wiring between the DLC-RC and DLC-XP is incorrect.

Refer to **Section 7 – General Operation: Calibration** for more detailed information on calibration features and procedures.

### 6.1.12 Wrapping up.

Your PULSAR DLC-XP/RC is now commissioned for manual use. Refer to **Section 7 – General Operation** for specific instructions on how to access your DLC-XP/RC's advanced features. Don't be intimidated by your DLC, take time to explore and experiment with its features. You cannot configure the software in a way that would damage the DLC-XP/RC. Whenever you are about to set a critical value (e.g., Calibrate Flow), you are always prompted to confirm your change before it takes effect. And if you are ever dissatisfied with the configuration of your DLC-XP/RC, you can always return to the Factory Defaults by repeating **Section 6.1.7**.

## 7. General Operation

This section covers the General Operation of the DLC as it relates to software. It includes detailed instructions and example screens to aid the user. The default values of the DLC have been factory set. The user can over-ride these settings to tune the DLC to his/her particular needs.

### 7.1 Calibration

The DLC can be calibrated for Flow, Analog Input and Analog Output. You should perform calibration on all three parameters (or any that are to be used) upon installation of the PULSAR DLC into your system.



**If no keys are pressed for 5 minutes during the calibration sub-menus, the present input will be aborted and the original screen will return.**

#### 7.1.1 Pump Flow Calibration

Pulsafeeder recommends performing at minimum a 1-Point flow calibration on every PULSAR DLC installed. Maintenance re-calibration should be performed periodically -- at least every three to four months -- to account for component wear. Re-calibration of the pump is also recommended whenever wet-end components are replaced.

1. Press [CAL] to enter the Calibration Menu. If the screen {CALIBRATE / PUMP FLOW} is not displayed, press [UP] until it appears. Press [ENTER] to go to the calibrate pump flow sub-menu:

**CALIBRATE  
PUMP FLOW**

Press  
[ENTER]

2. The DLC displays the last time the pump was calibrated. This provides a key record for the user. Press [ENTER] to continue with pump flow calibration.

**LAST FLOW CAL  
3:25 4/26/00**

Press  
[ENTER]

3. The display shows {FLOW CALIBRATION / 1 POINT}. The '1 POINT' text will be flashing

**FLOW CALIBRATION  
1 POINT**

Press  
[UP]

Press [UP] to change the flow calibration to 2 points, 3 points, 4 points or 5 points. The calibration points correspond to the following stroke length values:

1 point	100%
2 points	10 and 100 %
3 points	10, 50 and 100%
4 points	10, 25, 50 and 100%
5 points	10, 25, 50, 75 and 100%

These percentage values correspond to the API standard. If you continue to press [UP] you will also see the following options: {CHANGE CONSTANTS} and {TUNE}. These options are for use after a multi-point calibration has been performed. They are explained in more detail in steps 4 and 5 below. For a standard multi-point calibration, set the number of calibration points to use and press [ENTER] to continue. Skip 4 and 5 below. Proceed to step 6.

4. **CHANGE CONSTANTS.** Press [UP] until {CALIBRATION / CHANGE CONSTANTS} appears. This option is used to set the slope and Y-intercept in the equation that describes the linear calibration curve:  $y = ax + b$ . Where 'a' is the slope and 'b' is the Y-intercept. The input to this equation (i.e., x) is given in percent (%). The output (i.e., y) uses the currently displayed unit for flow. The units for the constants are given on screen. Values can be calculated from two or more flow readings and associated stroke settings. Press [ENTER] and the display prompts the user to enter the slope value:

**SLOPE %/GPM**  
**37.85601**

Use [UP] and [DOWN] to enter the calculated slope value in the displayed units (%/GPM in the example above). Press [ENTER]. The display prompts the user to enter the Y-intercept.

**Y-INTERCEPT**  
**0.00%**

Use [UP] and [DOWN] to enter the correct calculated value. Press [ENTER] to accept and continue through the calibration pump flow change constants sub-menu. The DLC will convert the constants to the other display units automatically. Proceed to step 6.

5. **TUNE.** Press [UP] until {CALIBRATION / TUNE} appears. In this sub-menu the flow curve can be shifted to tune the flow to one given point. Before entering the TUNE sub-menu, you should measure the actual flow rate at a specific stroke setting. For example, the DLC is currently set at 60.0% stroke and it displays a calibrated flow rate of 3.725 GPH. An actual flow measurement is taken and found to be 3.500 GPH. The process is critical and cannot be shut down for a full calibration. Leaving the stroke setting at 60%, change the units to GPH. Enter the CALIBRATE / TUNE menu. The following screen is displayed:

**TUNE FLOW 60.0%**  
**3.7251 G**

Using [UP] and [DOWN], set the value to 3.500. Press [ENTER]. The pump will now display the 3.500 value at the 60.0% stroke setting. Internally, the DLC has retained the slope calculated at the last calibration and has off-set the flow curve to satisfy the current reading requirement. Proceed to step 8.

6. The DLC – XP will now perform a ZERO CALIBRATION. First it will test its optical encoder by increasing the stroke adjustment mechanism 1%. Then the DLC will adjust the mechanism until it reaches the PULSAR's mechanical zero stop. Together, these steps ensure that calibrations will be accurate. The screen will display one of three messages:

**PLEASE WAIT**  
**CALIBRATING ZERO**

or

**TURN MOTOR ON**  
**CALIBRATING ZERO**

or

**ENCODER ERROR 0**  
**PRESS ENTER**

If you get the {TURN MOTOR ON...} screen, start the PULSAR motor by pressing [MOTOR]. If you get the {ENCODER ERROR ...} screen, refer to the section 11-Trouble Shooting Guide.

7. The DLC – XP will drive to the 0.0% stroke length position. Once the zero calibration has been completed, the following screen is displayed:

**PLEASE WAIT**  
**XXX.X% 100%**

Where XX% is the current stroke length adjustment setting and 100% is the stroke length destination. The DLC will adjust from the 0% to the 100% position.

8. Once the destination setting has been reached, the PULSAR motor will shut down and the display will show:

**ENTER TO START**  
**26.415 G**

The display is now displaying the current stroke setting (e.g., 100%), and the amount of fluid discharged from the pump the last time this operation was performed (e.g., 26.4157 Gallons). Based on this information, fill the calibration column in the system to the proper level to avoid running the pump dry during calibration.

9. When you are ready, press [ENTER]. This will start the pump motor for a period of 60 seconds. The display will show a 60 second timer and its count down toward 0 seconds. During this time, the pump is operating at the first calibration stroke length setting.

<p><b>TIMER 60 SEC</b> <b>26.415 G</b></p>
--

10. At the end of 60 seconds, the pump motor will automatically turn off. The display will automatically change to prompt the user to enter the new measured flow rate.

<p><b>ENTER VALUE 100%</b> <b>26.415 G</b></p>
--

Read the new measured flow rate from the calibration column. Enter the new value using [UP] and [DOWN]. Press [ENTER] to accept this value and the cursor moves to the next position. Continue to use [UP] and [DOWN] and press [ENTER] to accept your selections.

11. If a 2 through 5 point calibration was selected, the DLC – XP will automatically proceed to the next stroke length setting and repeat steps 6,7, and 8 as described above. After the DLC – XP has completed the above referenced process for all stroke length settings, it prompts the user to accept the data collected in the above referenced steps:

<p><b>CONFIRM CHANGE?</b> <b>YES</b></p>
--

12. Press [ENTER] to accept the calibration. If you do not want to accept the new calibration curve, press [UP] o scroll to {NO} and press [ENTER]. The DLC will display a {PLEASE WAIT} message while it performs the Least Squares curve fit to the data points and calculates the new flow curve.

The display will then return to its original operating mode.

## 7.1.2 Analog Input Signal Calibration

The DLC will accept analog input signals of 0-20 mA, 4-20 mA, 1-5 mA, or 1-5 volts. The analog input signal should be calibrated to each system.

1. Press [CAL]. Press [UP] to scroll to {CALIBRATE / ANALOG IN}. Press [ENTER] to go to the Calibrate Analog Input sub-menu.

<p><b>CALIBRATE</b> <b>ANALOG IN</b></p>
--

2. The display shows the previous 0% and 100% analog signal values:

<p><b>0% = 4 mA</b> <b>100% = 20 mA</b></p>
---



If you would like to skip the calibration and change only the Signal Ratio, press both [UP] and [DOWN] simultaneously. Skip to step 5.

3. Press [ENTER]. The display prompts you to input the minimum analog signal value, 0%.

<p><b>INPUT ANALOG MIN</b> <b>0% = XX mA</b></p>
--

Send the low analog signal to the DLC – XP (0 mA, 4 mA, 1 mA or 1 volt) from the control room. Refer to **Section 5 – Installation: Low Voltage Input** and **Figure 6** for wiring instructions. It is highly recommended that you use the actual signal the DLC – XP will be receiving in order to properly configure the settings. The DLC – XP will display its interpretation of the received signal. Do not be alarmed if the signal does not match the instrument. For example, your instrument is generating 4.0mA but the DLC display reads 3.68mA. It is only important that the DLC – XP detects the full range of the instrument's output. The DLC – XP will digitally store this value as the 0% analog signal value. As the analog signal varies, the DLC – XP will display the fluctuating values. Wait until the value displayed stabilizes and press [ENTER] to accept it as the 0% analog signal value.

4. The display prompts the user to input the maximum analog signal value, 100%. The user sends the analog signal to the DLC – XP (20 mA, 10 mA or 5 volts).

<p>INPUT ANALOG MAX 100% = XX mA</p>
--

As the signal varies, the DLC – XP will display the fluctuating values. Wait until the value stabilizes and press [ENTER]. This value will be digitally stored as the 100% analog signal value.



**If the range between the minimum and maximum analog signal values is less than 2 mA, the DLC – XP will display the following:**

<p>RANGE TOO SMALL RE-ENTER</p>
-------------------------------------

Press [ENTER] to return to step 3 to input the analog signal values again.

5. You are now ready to set the Signal Ratio. This option allows you to scale the Analog signal input to the pump output. Use this option only if you want to limit the range of operation of the pump (e.g., you want to limit the pump's output from 0 to 50% over the 4-20mA range). The display reads as follows:

<p>INPUT RATIO 100% = 19.8mA</p>
--------------------------------------

To use the ratio option, use [UP]/[DOWN] and [ENTER] to enter each position of the ratio value. In the example above, the line located under the left hand digit represents the character being changed. After setting the desired value for the first position (1 in this case), press [ENTER] and the line under the digit will move to the next digit. Continue to use [UP] and [DOWN] in conjunction with [ENTER] to set the correct percentage. Press [ENTER] to accept the complete menu.



**Note: If you do not want to use the Input Ratio Option, enter a value of 100%.**

6. The DLC – XP prompts the user to accept the analog signal calibration programmed in the above referenced steps.

<p>CONFIRM CHANGE? YES</p>
--------------------------------

Press [ENTER] to accept. If you do not want to accept the new analog signal calibration, press [UP] to scroll to {NO} and press [ENTER]. The display will then return to its original operating mode.



### 7.1.3 Reverse Acting Analog Input Signal Calibration

To set up a reverse acting application, follow the above Analog Input Calibration procedure with the following changes to step 3 and 4:

1. In step 3, when the display requests the minimum analog signal value (0%), the user should send the DLC – XP the high analog signal value (20 mA, 10 mA or 5 volts).

<b>INPUT ANALOG MIN</b> <b>0% = XX mA</b>	Send High (20mA) Signal
--	----------------------------

The DLC – XP will digitally store this as the 0% analog input signal value. As the analog signal varies, the DLC – XP will display the fluctuating values. Wait for the signal to stabilize. Press [ENTER] to accept this as the 0% analog signal value.

2. In step 4, when the display requests the maximum analog signal value (100%), the user sends the DLC – XP the low analog signal value (0 mA, 4 mA, 1 mA or 1 volt).

<b>INPUT ANALOG MIN</b> <b>1000% = XX mA</b>	Send Low (4mA) Signal
---	--------------------------

The DLC – XP will digitally store this as the 100% analog input signal value. As the signal varies, the fluctuating values are displayed. Wait for the signal to stabilize. Press [ENTER] to accept this signal as the 100% analog signal value.

You can confirm the reverse calibration by re-entering the Analog Input Calibration menu. The first screen summarizes your calibration.

### 7.1.4 Analog Output Signal Calibration

The DLC – XP will generate an analog output signal proportional to the current stroke setting. The signal can be in the range of 0-20 mA, 4-20 mA, 1-5 mA, or 1-5 volts. It should be calibrated to the attached system.

1. Press the [CAL] key to enter the {CALIBRATE} sub-menu. Press the [UP] arrow to scroll to the ANALOG OUTPUT selection:

<b>CALIBRATE</b> <b>ANALOG OUTPUT</b>
--

2. Press [ENTER]. The screen that allows you to set the output at 0% is displayed.

<b>OUTPUT AT 0%</b> <b>4.0 mA</b>
--------------------------------------

Using [UP] and [DOWN], set the value for the desired output. Keep in mind that the value that you set is for reference only.

If you need a true 4.0 mA at the remote equipment, you should read the actual value from the remote equipment and set the value here at what ever is required by that equipment. For example, say a remote PLC needs exactly 4.0mA's at 0% stroke. The PLC currently reads its input as 3.8mA and the DLC – XP reads its output as 4.0mA. Increase the DLC – XP output (e.g., 4.2) until the PLC reads correctly.

3. Once you have set the value press [ENTER] to accept. The screen that allows you to set the output at 100% is displayed.

<b>OUTPUT AT 100%</b> <b>20.0 mA</b>
---

As described in step 2, set the output using [UP] and [DOWN]. When you are satisfied with your settings press [ENTER] to accept.

- The DLC – XP will prompt you to accept the analog output calibrated values.

**CONFIRM CHANGES?  
YES**

Press [ENTER] to accept the calibration. If you do not want to accept, press [UP] and then [ENTER].  
The display will return to the standard operating mode.

## 7.2 Menu

The default values and menus of the DLC – XP Stroke Length Controller have been factory set, but you will want to configure the DLC – XP to meet your specific application.

The [MENU] key activates the Configuration Sub-menu system. This consists of 17 different sub-menus as shown below. Use [UP] and [DOWN] to scroll through the sub-menus.

<b>-MENU- DIAGNOSTICS-0</b>	Press [UP]	<b>-MENU- SET TIME AND DATE</b>	Press [UP]	<b>-MENU- ANALOG SIG FAIL</b>
<b>-MENU- LEAK DETECTION</b>	Press [UP]	<b>-MENU- LEVEL SWITCH</b>	Press [UP]	<b>-MENU- DIGITAL OUTPUT</b>
<b>-MENU- MOTOR THERMOSTAT</b>	Press [UP]	<b>-MENU- OVER TEMPERATURE</b>	Press [UP]	<b>-MENU- POWER FAILURE</b>
<b>-MENU- ALARM RELAY</b>	Press [UP]	<b>-MENU- ANALOG MODE</b>	Press [UP]	<b>-MENU- SECURITY</b>
<b>-MENU- NUMBER FORMAT</b>	Press [UP]	<b>-MENU- CONTRAST ADJUST</b>	Press [UP]	<b>-MENU- SERIAL COMM</b>
<b>-MENU- LANGUAGE</b>	Press [UP]	<b>-MENU- FACTORY DEFAULTS</b>		

### 7.2.1 Diagnostics

The DLC – XP is supplied, as standard with a complete Diagnostic menu. It will alert the user if something has failed; the time and date of the failure; and prompt the user to clear the failure.

- Press the [MENU] key. In a normal condition, the display reads {MENU / DIAGNOSTICS-0}. Press the [ENTER] key and the complete sub-menu for the diagnostics is displayed.

**-MENU-  
DIAGNOSTICS-0**

If a diagnostic failure was detected, the {DIAGNOSTICS - #} message would appear. The '#' indicates the number of failures that has occurred.

- Press [ENTER] and the first diagnostic sub-menu is displayed.
  - If the incoming power supply to the DLC – XP is interrupted while the PULSAR motor is running, a failure will be detected and logged.

**DIAG MENU 1/11  
POWER IN: OK**

or

**DIAG MENU 1/11  
POWER IN: FAIL**

- b) Press [UP] to scroll to the next sub-menu. If the analog signal failed (i.e., it went outside of its calibrated range or fell below 0.3mA at a rate of 2.2mA per second), a failure would be detected and logged.

<b>DIAG MENU 2/11</b> <b>ANALOG IN: OK</b>	or	<b>DIAG MENU 2/11</b> <b>ANALOG IN: FAIL</b>
---	----	---

- c) Use [UP] to scroll to the next sub-menu. If serial communications fail, a failure would be detected and logged.

<b>DIAG MENU 3/11</b> <b>DIGITAL: OK</b>	or	<b>DIAG MENU 3/11</b> <b>DIGITAL: FAIL</b>
---	----	---

- d) Use [UP] to scroll to the next sub-menu. If a PULSAlarm diaphragm rupture was detected, the DLC – XP would show a failure in this diagnostic sub-menu.

<b>DIAG MENU 4/11</b> <b>LEAK DET: OK</b>	or	<b>DIAG MENU 4/11</b> <b>LEAK DET: FAIL</b>
--	----	--

- e) Use [UP] to scroll to the next sub-menu. If the drum level relay was activated, the DLC – XP would show a failure in this diagnostic sub-menu.

<b>DIAG MENU 5/11</b> <b>LEVEL SW.: OK</b>	or	<b>DIAG MENU 5/11</b> <b>LEVEL SW.: FAIL</b>
---	----	---

- f) Use [UP] to scroll to the next sub-menu. The NEMA 7 version of the DLC (XP/RC) does not have a motor temperature sensor.

<b>DIAG MENU 6/11</b> <b>MOTOR TEMP: N/A</b>
---

- g) Use [UP] to scroll to the next sub-menu. The DLC – XP is equipped with a thermistor to monitor internal enclosure temperatures. If the temperature approaches its operating limit, the DLC – XP would show a warning in this diagnostic sub-menu.

<b>DIAG MENU 7/11</b> <b>DRIVE TEMP: OK</b>	or	<b>DIAG MENU 7/11</b> <b>DRIVE TEMP: FAIL</b>
--	----	--

- h) Use [UP] to scroll to the next sub-menu. The DLC – XP is equipped with a clock that is backed by a 10-year lithium battery. If the battery life fails, the DLC – XP would show a failure in this diagnostic sub-menu. The error is automatically cleared when the new battery is installed and powered.



**The DLC – XP will continue to operate off the external power supply. The clock and battery backed RAM will not function if the power supply is interrupted.**

<b>DIAG MENU 8/11</b> <b>BATTERY: OK</b>	or	<b>DIAG MENU 8/11</b> <b>BATTERY: FAIL?</b>
---	----	--

- i) Use [UP] to scroll to the next sub-menu. If the RAM, EEPROM or internal synchronous DLC – XP motor fail, the DLC – XP would show the failure, flashing, in this diagnostic sub-menu. The error is automatically cleared when the new component is replaced and powered.

<b>DIAG MENU 9/11</b> <b>CIRCUIT: OK</b>	or	<b>DIAG MENU 9/11</b> <b>CIRCUIT: FAIL</b>
---	----	---

You can access a sub-menu from the above screen by pressing [ENTER] if a circuit failure has occurred. The lower level menus show more descriptive circuit information. The DLC – XP performs a self-test at power-up. The values in the menus shown below are updated during power-up. Use [UP] to scroll between sub-menus.

<b>CIRCUIT FAILURE</b> <b>RAM: OK</b>	or	<b>CIRCUIT FAILURE</b> <b>RAM: FAIL</b>
<b>CIRCUIT FAILURE</b> <b>EEPROM: OK</b>	or	<b>CIRCUIT FAILURE</b> <b>EEPROM: FAIL</b>
<b>CIRCUIT FAILURE</b> <b>MOTOR: OK</b>	or	<b>CIRCUIT FAILURE</b> <b>MOTOR: FAIL</b>

- j) Use [UP] to scroll to the next sub-menu. The total pump operating time is displayed in this diagnostic sub-menu. If a failure is detected in one of the other diagnostic sub-menus, by pressing [ENTER] the user is prompted to reset the total run time or continue counting the total operating hours.

<b>DIAG MENU 10/11</b> <b>RUN :XXX HRS</b>	Press [ENTER]	<b>RESET RUN TIME</b> <b>YES</b>
---	------------------	-------------------------------------

- k) Use [UP] to scroll to the next sub-menu. The NEMA 7 version of the DLC (XP/RC) does not have a tachometer for a stroke counting capability.

<b>DIAG MENU 11/11</b> <b>STROKES: N/A</b>
---

3. Pressing [ENTER] on the screens depicted in steps a, b, c, d, e, and g above will display the time and date of the failure or more descriptive information.

<b>POWER FAILURE</b> <b>13:27 4/26/00</b>
--

4. Press [ENTER] again, and the user is prompted to clear the failure. Depending upon the type of failure diagnosed, the user may want to take other steps before clearing the failure and restarting the pump. If so, press [ENTER] to keep the error date and time stamp. Otherwise, use [UP] to scroll to "YES" and press [ENTER]. The DLC – XP will return to a normal condition.

<b>POWER FAILURE</b> <b>CLEAR? NO</b>
--



**If more than one failure occurred, repeat steps 3 and 4 above for each sub-menu that indicates a failure was detected.**

## 7.2.2 Set Time and Date

The clock/calendar is essential to the proper operation of the batching system and proper error time stamping. The clock should be set at installation time. It can be configured to operate without any additional maintenance in most time zones.

1. Press the [MENU] key, then press [UP] until the –MENU–/SET TIME & DATE is displayed:

**–MENU–  
SET TIME & DATE**

Press [ENTER] to access the Set Time and Date sub-menu.

2. Flashing in the upper left hand corner of the display should be "12 HR", which denotes a 12 hour clock with a.m. or p.m. time. By pressing [UP], you can change this to a 24 hour ("24 HR") clock for international time.



**The 24 hour clock removes the "a" or "p" after the time. Press [ENTER] to accept the desired configuration.**

**12 HR    MM/DD/YY  
2:31a    4/26/00**

3. The time will now be flashing with the cursor located under the hour position. Use [UP] and [DOWN] to adjust the time to your local standard time. The cursor located under the digit in the time, represents the character being changed (flashing). Once the hour is set, press [ENTER] and the digit will stop flashing and it will move to the first digit in the minute setting. Continue to use [UP] and [DOWN] in conjunction with [ENTER] to set the correct time and a.m. (a) or p.m. (P).

**12 HR    MM/DD/YY  
2:31a    4/26/00**

4. The date format will now be flashing on the display. The date can be expressed in one of three formats:

Month, Day, Year	MM/DD/YY
Day, Month, Year	DD/MM/YY
Year, Month, Day	YY/MM/DD

Use [UP] and [DOWN] to scroll through the above referenced formats. When the format you desire is displayed, press [ENTER] to accept this format and continue.

5. The date is now be flashing on the display. Use [UP] and [DOWN] to change this to the current date. Press [ENTER] to accept this value and the cursor moves to the next date position. Continue to use [UP] and [DOWN] . Press [ENTER] to accept your selections.

**12 HR    MM/DD/YY  
2:31a    4/26/00**

6. The DLC – XP prompts the user to change the time and date for DAYLIGHT SAVINGS TIME. The display states {AUTO CHANGE} or use [UP] to scroll to {NO}. Press [ENTER] to accept the correct configuration based on the location of the DLC – XP.

**DAYLIGHT SAVINGS  
AUTOCHANGE**

7. If {AUTO CHANGE} was accepted in the previous step, the DLC – XP prompts the user for the current day of the week. Press the [UP] arrow to scroll through the days of the week. Press [ENTER] to accept the current day of the week.

**DAY OF THE WEEK  
WEDNESDAY**

8. The DLC prompts the user to accept the date programmed in the above referenced steps, {CONFIRM CHANGE}. Press [ENTER] to accept. If you do not want to accept the new inputs, press the [UP] arrow to scroll to "NO" and press [ENTER].

**CONFIRM CHANGE?**  
**YES**

9. The display will return to the main {SET TIME & DATE} menu.

### 7.2.3 Analog Signal Failure Set Up

This sub-menu allows the user to set up the DLC – XP response if the analog signal fails. You can program the DLC – XP to have one of the following responses:

- Freeze at the last analog input signal
- Go to a default signal
- Shut the motor off.

You can also configure the DLC – XP to enter manual mode (user intervention required) or to resume (no user intervention) when the signal is restored.

1. Press [MENU] and [UP] two times. The display will read {-MENU- / ANALOG SIG FAIL}. Press [ENTER] to continue to the analog signal fail sub-menu.

**-MENU-**  
**ANALOG SIG FAIL**

2. The first entry in the Analog Signal Failure menu concerns how the DLC – XP should recover from a failed analog input.

**RESTORE TO:**  
**ANALOG MODE**

or

**RESTORE TO:**  
**MANUAL MODE**

You can select from 2 {RESTORE TO:} modes: Analog or Manual. If {ANALOG MODE} is selected, the DLC – XP will resume following the 4-20mA input when the signal is restored. If {MANUAL MODE} is selected, the DLC – XP will enter the manual mode as soon as the signal loss is detected. It will remain in manual mode until it is changed manually -- [MODE] is pressed on the front panel. The benefit of using a {RESTORE TO: / ANALOG MODE } is that no user intervention is required. If so programmed, the DLC – XP can shut itself down and wait for the signal to return.

Press [ENTER] to accept your selection. The DLC – XP returns to the {-MENU- / ANALOG SIG FAIL} screen.

- a) The menu for having the DLC – XP freeze at the last signal is displayed. To accept this action, press [ENTER].

**ANALOG SIG FAIL**  
**FREEZE @LAST SIG**

If the user desires a different response, press [UP].

- b) The menu for having the DLC – XP/RC shut the motor off is displayed. To accept this action, press [ENTER].

**ANALOG SIG FAIL**  
**MOTOR OFF**

If the user desires a different response, press [UP].

- c) The menu for having the DLC – XP go to a default signal is displayed. To accept this action, press [ENTER].

**ANALOG SIG FAIL**  
**GO TO DEFAULT**

The display prompts the percent of flow as the default setting. Enter the new value using [UP] and [DOWN]. Press [ENTER] to accept this value and the cursor moves to the next position. Continue to use the arrow keys and press [ENTER] to accept your selections.

<b>SIGNAL DEFAULT</b> <b>000.0% FLOW</b>
---

- Pressing [ENTER] after configuring any of the previous steps (a-d) accepts your selection and will additionally open an {ERROR MESSAGE / .....} screen.

<b>ERROR MESSAGE</b> <b>ENABLED</b>	or	<b>ERROR MESSAGE</b> <b>DISABLED</b>
--	----	---

Press [UP] or [DOWN] to select between ENABLED or DISABLED. Press [ENTER] to accept this value. At this time the display is returned to the {-MENU- / ANALOG SIG FAIL} screen.

## 7.2.4 Leak Detection Failure Set Up

This sub-menu allows you to configure the DLC – XP to interact with a PULSAlarm Leak Detection Diaphragm. You can modify the way the DLC – XP responds to the diaphragm rupture. The following responses are available:

- Shut the motor off
- Trigger an alarm relay
- Shut the motor off and trigger an alarm relay.

Refer to *Section 5 – Installation: Low Voltage Inputs* for wiring information.

- Press [MENU] to enter the {-MENU-} sub-system. Press [UP] three times until the {-MENU- / LEAK DETECTION} is displayed. Press [ENTER] to continue to program the Leak Detection options.

<b>-MENU-</b> <b>LEAK DETECTION</b>
--

- The Leak Detection Input can be configured as {INACTIVE}, if the pump is not supplied with a PULSAlarm Leak Detection Diaphragm. Press [ENTER] to return to the screen {MENU / LEAK DETECTION}.

<b>LEAK DET INPUT</b> <b>INACTIVE</b>
--

- Press [UP] to scroll to the next sub-menu. The Leak Detection Input relay can be configured as {NORMALLY OPEN}.

<b>LEAK DET INPUT</b> <b>NORMALLY OPEN</b>
---

or

- Press [UP] to configure the relay as {NORMALLY CLOSED}.

<b>LEAK DET INPUT</b> <b>NORMALLY CLOSED</b>
---

Press [ENTER] to accept the desired configuration.

- The display prompts for you to configure the motor state (ON/OFF) should a diaphragm rupture occurs (leak is detected).

<b>LEAK DETECTION</b> <b>MOTOR OFF? NO</b>	or	<b>LEAK DETECTION</b> <b>MOTOR OFF? YES</b>
---	----	--

Press [ENTER] to accept. If you do want to shut the motor off is a leak is detected, press [UP] to scroll to {YES} and press [ENTER].

4. The display prompts if the alarm relay should be triggered.

LEAK DETECTION  
ALARM RELAY? NO

or

LEAK DETECTION  
ALARM RELAY? YES

Press [ENTER] to accept the default of NO. If you want the alarm relay to active if a leak is detected, press [UP] to scroll to {YES} and press [ENTER]. The display returns to the {MENU / LEAK DETECTION} screen.

## 7.2.5 Level Switch Failure Set Up

This sub-menu allows the user to configure the DLC – XP to interact with a single point level sensor. You can program one of the following responses:

- Shut the motor off,
- Trigger the alarm relay'
- Shut the motor off and trigger the alarm relay.



**The level sensor must be a dry contact type. Refer to Section 5 – Installation: Low Voltage Input Connections.**

1. Press the [MENU] key and [UP] four times until the {-MENU- / LEVEL SWITCH} screen is displayed.

-MENU-  
LEVEL SWITCH

Press [ENTER] to continue to program the Level Switch sub-menu.

2. The low level input can be configured as {INACTIVE}, if the system will not use a level sensor or as {ACTIVE} if the system is going to use a level sensor.

LEVEL SWITCH  
INACTIVE

Pressing [ENTER] when {INACTIVE} is displayed will cause the screen to return to the {-MENU- / LEVEL SWITCH} screen. Skip to step 9.

Pressing [UP] when {INACTIVE} is displayed will cause the screen to display {ACTIVE}. Continue with step 3.

3. The low level input can be configured as {ACTIVE}, if the system will use a level sensor.

LEVEL SWITCH  
ACTIVE

Pressing [ENTER] when {ACTIVE} is displayed will open the {LEVEL SWITCH / DRUM LEVEL} screen.

LEVEL SWITCH  
DRUM LEVEL

or

LEVEL SWITCH  
START/STOP

Press [UP] to scroll to the next option {LEVEL SWITCH / START/STOP}

Press [ENTER] to make your selection and the following screen is displayed.

LEVEL SWITCH  
NORMALLY OPEN

4. The input can be configured as {NORMALLY OPEN} by pressing [ENTER], or press [UP] to scroll to the next input option (i.e., Normally Closed).

LEVEL SWITCH  
NORMALLY CLOSED

Press [ENTER] to accept the desired configuration.



5. The display will then prompt for the motor status when the Level Switch input trips:

**LEVEL SWITCH  
MOTOR OFF? NO**

Press [ENTER] if you DO NOT want the PULSAR motor to turn off when the input is sensed. Go to step 7.

6. If you do want the PULSAR motor to shut off is a low level is sensed, press [UP] to scroll to {YES}. Press [ENTER].

**LEVEL SWITCH  
MOTOR OFF? YES**

7. The display prompts you for the alarm relay status should Level Switch input trigger.

**LEVEL SWITCH  
ALARM RELAY? NO**

Press [ENTER] if you do not want the Alarm Relay to activate with the Level Switch input. Go to step 9.

8. If you want the Alarm Relay to activate with the Level Switch input, press the [UP] arrow key to scroll to {YES}. Press [ENTER] to accept the setting.

**LEVEL SWITCH  
ALARM RELAY? YES**

9. The display returns to the {MENU / DRUM LEVEL} screen.

## 7.2.6 Digital Output Set Up

This sub-menu is not functional with the NEMA 7 option.

## 7.2.7 Motor Thermostat Set Up

This sub-menu is not functional with the NEMA 7 option.

## 7.2.8 Over Temperature Set Up

This sub-menu allows you to disable the warning message when the DLC's internal temperature approaches it's operating limit of 70°C / 158°F. The error condition will not reset until the temperature drops below 65°C / 149°F. The difference between the trip and release point is 5°C / 9°F.

1. Press [MENU] once and then [UP] seven (7) times until the display reads {– MENU – / OVER TEMPERATURE}.

**– MENU –  
OVER TEMPERATURE**

Press [ENTER] to go to the Over Temperature sub-menu.

2. The {OVER TEMPERATURE / ENABLED} (system default) screen is displayed.

**OVER TEMPERATURE  
ENABLED**

3. Press [ENTER] to accept the {ENABLED} setting and you are returned to the {– MENU – / OVER TEMPERATURE} screen.

or

Press [UP] to display the {OVER TEMPERATURE / DISABLED} screen.

**OVER TEMPERATURE  
DISABLED**

Press [ENTER] to accept the {DISABLED} setting. The display will return to the {- MENU - / OVER TEMPERATURE} screen.

- MENU -  
OVER TEMPERATURE

## 7.2.9 Power Failure Set Up

This sub-menu allows you to configure the way the DLC-XP/RC reacts to a power outage. During the power up stage, your system can either:

- Return to settings that were active when the pump lost power, or
- Shut the motor off.



NOTE

**A power outage is defined as the loss of power when ever the DLC is not in {MOTOR OFF} state.**

1. Press the [MENU] key and [UP] eight times until the display reads {MENU / POWER FAILURE}.

-MENU-  
POWER FAILURE

Press [ENTER] to go the power failure response sub-menu.

2. The display prompts you for the Power-up status.
  - a) To keep the prior settings the power is returned to the unit (after a power failure), select the {PRIOR SETTINGS} option.

DURING POWER UP  
PRIOR SETTINGS

Press [ENTER] to accept.

- b) If you do want to return to prior settings and would like to shut the motor off, press [UP] to scroll to {MOTOR OFF}.

DURING POWER UP  
MOTOR OFF

Press [ENTER] to accept.

3. The display will return to the {MENU / POWER FAILURE} screen.

## 7.2.10 Alarm Relay

This sub-menu sets up the alarm relay output as normally open or normally closed.

1. Press the [MENU] key. Press [UP] nine times until the {MENU / ALARM RELAY} appears. Press [ENTER] to continue to program the Alarm Relay sub-menu.

-MENU-  
ALARM RELAY

2. The alarm relay can be configured as {NORMALLY OPEN}. With this setting the relay will CLOSE when the alarm output is activated.

RELAY OUTPUT  
NORMALLY OPEN

If you would rather have the relay OPEN when the output is activated, press the [UP] arrow key to change the configuration to {NORMALLY CLOSED}.

RELAY OUTPUT  
NORMALLY CLOSED

When you have finished making your selection, press [ENTER] to accept.

3. The display returns to the {-MENU- / ALARM RELAY}.

## 7.2.11 Analog Mode

Use the Analog Mode setting to activate the analog input. If you are not using the analog input, setting Analog Mode to Inactive will prevent errant operation if [MODE] is pressed accidentally.

1. Press [MENU]. Press [UP] seven times until the screen {-MENU- / ANALOG MODE} is displayed.

-MENU-  
ANALOG MODE

Press [ENTER] to continue to configure the analog mode.

2. Press [UP] and the {INACTIVE} option is displayed. If you are not using the analog input to control your DLC-XP, press [ENTER] to accept the inactive setting and return to the {-MENU-} level.

ANALOG MODE  
INACTIVE

3. Press [UP] and the {ACTIVE} option is displayed. If you are using the analog input to control your DLC, press [ENTER] to accept the active setting.

ANALOG MODE  
ACTIVE

4. The {SAMPLE SIZE / 10} screen is displayed. Use [UP] and [DOWN] to set the number of samples taken from the 4-20mA input to average. The DLC-XP will adjust its output to in accordance with the average of the number of samples you set here. The DLC-XP samples the port every .25 seconds. You may enter a value in the range of 1 to 100 samples.

Rule of Thumb: Increase the number of samples to smooth out a noisy input. Decrease the number of samples to cause the DLC to track more closely a rapidly changing signal.

SAMPLE SIZE  
10

5. The {UPDATE EVERY / 20 SAMPLES} screen will appear. Use [UP] and [DOWN] to set how often the DLC will adjust to the current average value. The default value (20) causes the DLC to adjust every 20 samples or every 5 seconds ( $20 * .25 = 5$ ). You may enter a value in the range of 1 to 100 samples.

Rule of Thumb: Increase the number of samples if the input is not changing rapidly. Decrease the number of samples if it is changing rapidly.

UPDATE EVERY  
20 SAMPLES

6. Press [ENTER] to accept the setting and return to the {-MENU-} level.

## 7.2.12 Security

The DLC is capable of three modes of security:

1. None (OFF)
2. Tamper Proof
3. Calibration

With Tamper Proof security active, the DLC-XP will lockout all of the front panel keys with the exception of [MOTOR]. To use any key you must first enter a four digit Personal Identification Number (PIN). Successful entry of a PIN allows you to access all functions without PIN re-entry. With Calibration security set, the DLC-XP will lockout only [CAL]. To use [CAL] you must first enter your PIN. Successful entry of a PIN allows the user to access the [CAL] menu.



**The security mode becomes active after 5-minutes of keypad in-activity.**

1. Press [MENU]. Press [UP] eleven times until the screen {MENU / SECURITY} appears.

**-MENU-  
SECURITY**

Press [ENTER] to continue to program the Security sub-menu.

2. The type of security available appears flashing on the display.
  - a) If no password security protection is desired, press [ENTER] and go to step 5.

**SECURITY TYPE  
OFF**

- b) Press [UP] and the {TAMPER PROOF} option will appear. If complete tamper proof security of all settings is required, press [ENTER] and go to step 3.

**SECURITY TYPE  
TAMPER PROOF**

- c) Press [UP] and the {CAL SETTINGS} option will appear. If security protection of the calibration settings is desired, press [ENTER].

**SECURITY TYPE  
CAL SETTINGS**

3. The display prompts the user to enter a four digit pin number. A line under the first digit indicates the character to be changed. Use [UP] and [DOWN] to scroll through the numbers 0-9. Press [ENTER] to accept the desired number. The line then moves to beneath the second digit. Continue to use the [UP], [DOWN] and [ENTER] keys to set the four digit password.

**NEW PIN #  
0000**

- a) After the four digit PIN has been entered, the display prompts the user to confirm the new number:

**CONFIRM CHANGE?  
YES**

Press [ENTER] to accept the pin number and go to step 4.

- b) If the pin number is not correct, press [UP] to change the display to

**CONFIRM CHANGE?  
NO**

Press [ENTER] to reject the pin number and go to step 4. The user would have to start again at step 1.

4. The menu display returns to the menu for security.

## 7.2.13 Number Format

The position of the comma and decimal point can be interchanged in the number format menu. Also, you can change the number of significant decimal places.

1. Press [MENU] and [UP] twelve times until the display reads {-MENU- / NUMBER FORMAT}. Press [ENTER] to continue into the decimal format sub-menu.

**-MENU-  
NUMBER FORMAT**

2. The display shows the English numerical format of 9,999.00. Press the [UP] to change to the European format.

**e.g. 9,999.99  
DECIMAL OR COMMA**

Press  
[UP]

**e.g. 9.999,99  
DECIMAL OR COMMA**

Press [ENTER] to accept the displayed format.

3. The decimal position screen is displayed. Use [DOWN] to move the decimal position one place to the left. For example, the screen displays 9.999, pressing [DOWN] causes the display to change to 0.9999. When the decimal position satisfies your needs press [ENTER] to accept.

e.g. 9.999 DECIMAL POSITION	Press [DOWN]	e.g. 0.9999 DECIMAL POSITION
--------------------------------	-----------------	---------------------------------

4. The display returns to {-MENU- / DECIMAL FORMAT}.

## 7.2.14 Contrast Adjust

The DLC contrast can be adjusted to a desired setting.

1. Press [MENU]. Press [UP] thirteen times until the display reads {-MENU- / CONTRAST ADJUST}.

-MENU-  
CONTRAST ADJUST

Press [ENTER] to continue in the contrast adjust sub-menu.

2. Use [UP] to darken the character on the display. Use [DOWN] to lighten the characters.

USE ARROWS TO  
ADJUST CONTRAST



By going too far in either direction the screen can be extremely difficult to read. Press the opposite arrow to correct the display.

3. Press [ENTER] to accept the desired contrast setting.
4. The display returns to the menu for Contrast Adjust.



You can adjust the contrast at any time by pressing the [MENU] and [UP] or [DOWN] arrow keys simultaneously.

## 7.2.15 Serial Communications

This sub-menu is not functional with the NEMA 7 option.

## 7.2.16 Language

The DLC menus can be displayed in English, Spanish, French or German.

1. Press [MENU]. Press [UP] fifteen times until the {MENU / LANGUAGE} appears flashing on the display.

-MENU-  
LANGUAGE

Press [ENTER] to continue through the language sub-menu.

2. The language type appears on the display. Press [UP] to display the available languages.

LANGUAGE ENGLISH	Press [UP]	LANGUAGE FRANCAIS
LANGUAGE DEUTSCH	Press [UP]	LANGUAGE ESPANOL

When the correct language displays, press [ENTER] to activate.

3. The display returns to the menu for languages.

## 7.2.17 Factory Default

All of the DLC settings can be returned to factory defaults.

1. Press [MENU] and then [UP] sixteen times until the {MENU / FACTORY DEFAULTS} appears flashing.

-MENU-  
FACTORY DEFAULTS

Press the [ENTER] key to continue through the factory defaults sub-menu.

2. The display prompts you to not reset all the settings to the factory defaults.

FACTORY RESET?  
NO

If this is not desired, press [ENTER] and go to step 4.

- a) If the DLC should be reset to all factory defaults, use [UP] to scroll the value to {YES}.

FACTORY RESET?  
YES

Press [ENTER] to accept.

3. The display double checks your action.



**Re-setting Factory Defaults will destroy any user calibration information.**

ARE YOU SURE?  
NO

Use [UP] to change the value to {YES}. Press [ENTER] to accept the value.

4. The display returns to the menu for factory defaults.

## 7.3 Units

By pressing the UNITS button, the calibrated flow display will scroll through GPH, LPH, CCH, GPM, LPM, CCM, or % stroke length setting. The DLC will automatically convert the flow rate, based on the calibrated flow, to any of the above referenced units.

## 7.4 Varying The Flow Rate - Manually

The flow of the pump can be increased pressing [UP]. The flow rate can be decreased by pressing [DOWN].

## 7.5 Mode

Pressing [MODE], switches the DLC-XP from MANUAL MODE, where the keypad is completely functional to ANALOG MODE, where the DLC follows the analog input signal. This key acts like a local auto/manual switch.



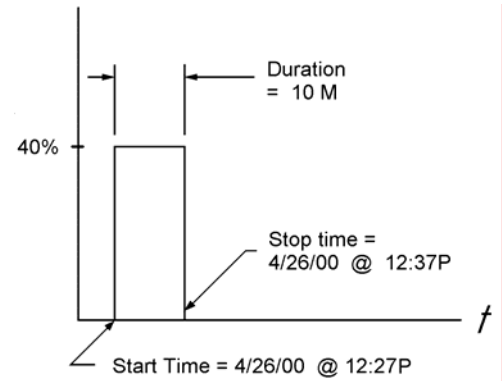
**In the analog mode, the [MOTOR], [MENU] and [UNITS] keys are still operational on the keypad.**

## 7.6 Batch

The DLC is capable of controlling up to three different batch programs. The batches operate in two modes: One Time Only and Repeating. All batches are based upon clock time.

### 7.6.1 One Time Only

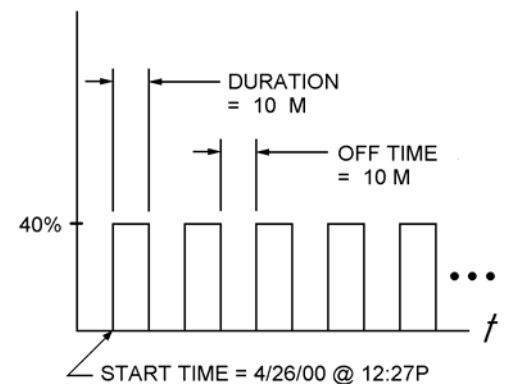
The One Time Only batch will start at a user specified time and run for a user specified duration.



### 7.6.2 Repeating

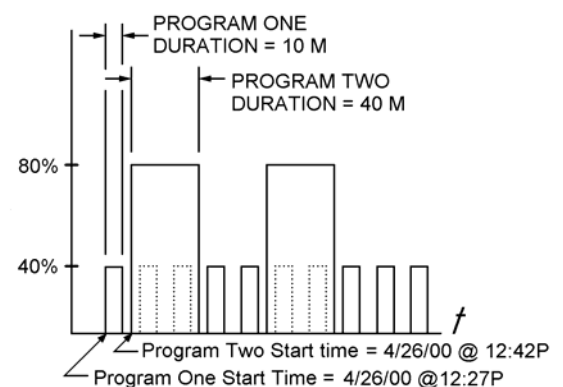
A Repeating Batch will start at a specified time and run for a specified duration. It stop for a specified period of time and then repeat the run time. This will continue indefinitely.

Any of the three batches can be specified as one time only or repeating.



### 7.6.3 Overlapped

The batches can also be overlapped.



When the batches are overlapped, the flow rates are NOT additive. The highest of the two or three flow rates is used.

### 7.6.3.1 Activating Batches

1. Press [BATCH], to enter the batch set-up menu..
2. The display will come up as {BATCHES / ACTIVE} or {BATCHES / INACTIVE}. Press the [UP] arrow to change the batch system to {ACTIVE}. Press [ENTER] to continue on to the batch sub-menu.



**You have now activated the batching system. If any pre-configured batches are scheduled to start they will start immediately.**

3. The display shows {EDIT / BATCH #1}. Press [UP] to {EDIT / BATCH #2} and [UP] again to {EDIT / BATCH #3}.



The DLC is supplied with three batches. Press [ENTER] to select the desired batch to edit.

4. The display shows {BATCH #1 RATE} with the word RATE flashing. Press [ENTER] to program the rate at which the batch will operate, (go to step 5) or press [UP] to continue through the batch menu and set up duration, go to step 6.

BATCH #1 RATE 92.5%
------------------------

5. The units of flow will now be flashing on the display. A line under the first digit indicates the character to be changed. Use [UP] and [DOWN] to scroll through the numbers 0-9. Press [ENTER] to accept the desired number. The line then moves to beneath the second digit. Continue to use [UP], [DOWN] and [ENTER] to set the correct rate of the batch. Continue to step 6.

BATCH #1 RATE 92.5%
------------------------



**The previously set value for the batch will appear upon entering. Pressing the UNITS key will change the units of flow.**

6. The display shows {BATCH #1 DURATION} flashing with a time. Press [ENTER] to program the duration of the batch, (go to step 7) or press [UP] to continue through the batch menu and set up type, (go to step 8).

BATCH #1 DURATION 12 HRS 30 MIN
------------------------------------

7. The units of time should now be flashing on the display. A line under the first digit indicates the character to be changed. Use [UP] and [DOWN] to scroll through the numbers 0-9. Press [ENTER] to accept the desired number. The line then moves to beneath the second digit. Continue to use [UP], [DOWN] and [ENTER] to set the correct duration of the batch (go to step 8).

BATCH #1 DURATION 12 HRS 30 MIN
------------------------------------

8. The display shows {BATCH #1 TYPE} flashing. Press [ENTER] to program the type of batch, (go to step 9) or press [UP] to go to START.

BATCH #1 TYPE ONE TIME ONLY
--------------------------------

9. The batch mode can complete either a one time only batch or a repeating batch. Press [UP] to scroll to the different batch types.



Press [ENTER] to select the type of batch desired.



10. If a Repeating batch is selected, the display prompts the user to enter the off duration of the batch.

**BATCH #1 OFF TIME**  
**10 HRS 23 MIN**

Press [UP] and [DOWN] to program the time the batch should be off. Press [ENTER] to accept the time and continue to step 10.

11. The display shows {BATCH #1 START TIME} flashing. Press [ENTER] to continue to the sub-menu or press [UP] to scroll to confirm the batch, (go to step 12).

**BATCH #1 START**  
**8:01P 4/26/00**

Press [UP] and [DOWN] to change the time and date of starting the batch. Press [ENTER] to continue to step 11.

12. The display prompts the user to {CONFIRM BATCH? / YES}. Press [ENTER] to confirm the batch or press [UP] to scroll to the {NO} menu; press [ENTER] to disregard the batch.

**BATCH #1 CONFIRM?**  
**YES**

13. The display changes to let the user know the batch is now pending and displays the time and date the batch will begin.

**BATCH #1 PENDING**  
**8:01P 4/26/00**

14. When the clock reaches the time and date of the batch, the display automatically changes to batch #1 running. The pump is operating at the specified rate, for the specified time.

**BATCH #1 RUNNING**  
**92.5%**

15. When the batch has operated for the specified time period, it will automatically shut off.  
a) If this a one time only, the display automatically changes to batch completed.

**BATCH COMPLETED**  
**PRESS ANY KEY**

The user then presses any key to return the display to manual mode.

**300,000 CCH**  
**MANUAL MODE**

- b) If this was a repeating batch, the display will return to step 12 and continue pending until the next start cycle.

**BATCH #1 PENDING**  
**8:05P 4/26/00**

### 7.6.3.2 Inactivating The Batches

If the batch operation is not required to operate over a certain period of time, for instance the weekend, the batches should be inactivated.

1. Press [BATCH]. Press [ENTER]. Batches should appear as "ACTIVE". Press [UP] to change the display to {BATCHES / INACTIVE}. Press [ENTER] to accept and inactivate the batches.

# 8. Diagrams: Installation / Component

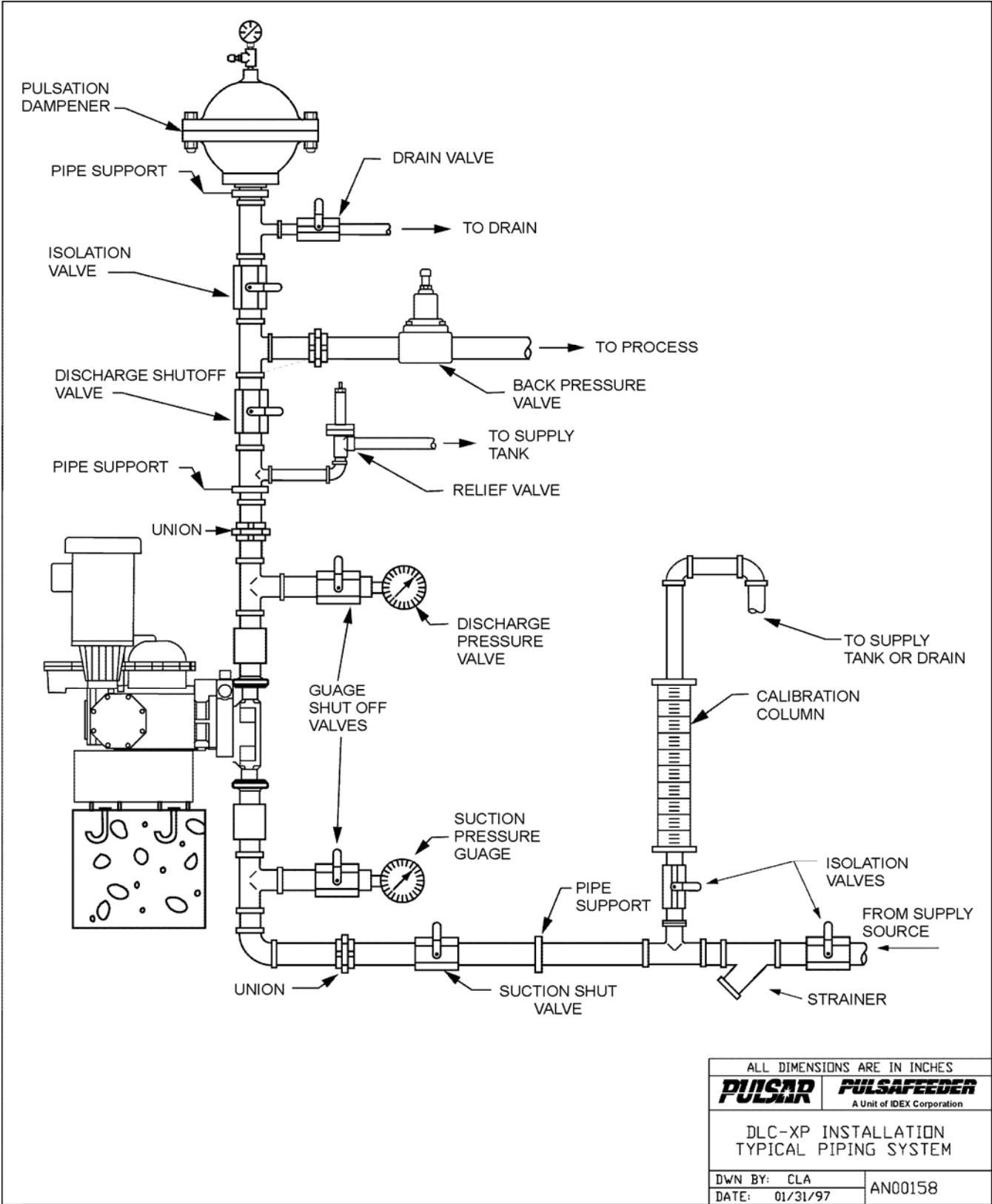


DIAGRAM 1. DLC-XP/RC INSTALLATION DRAWING.

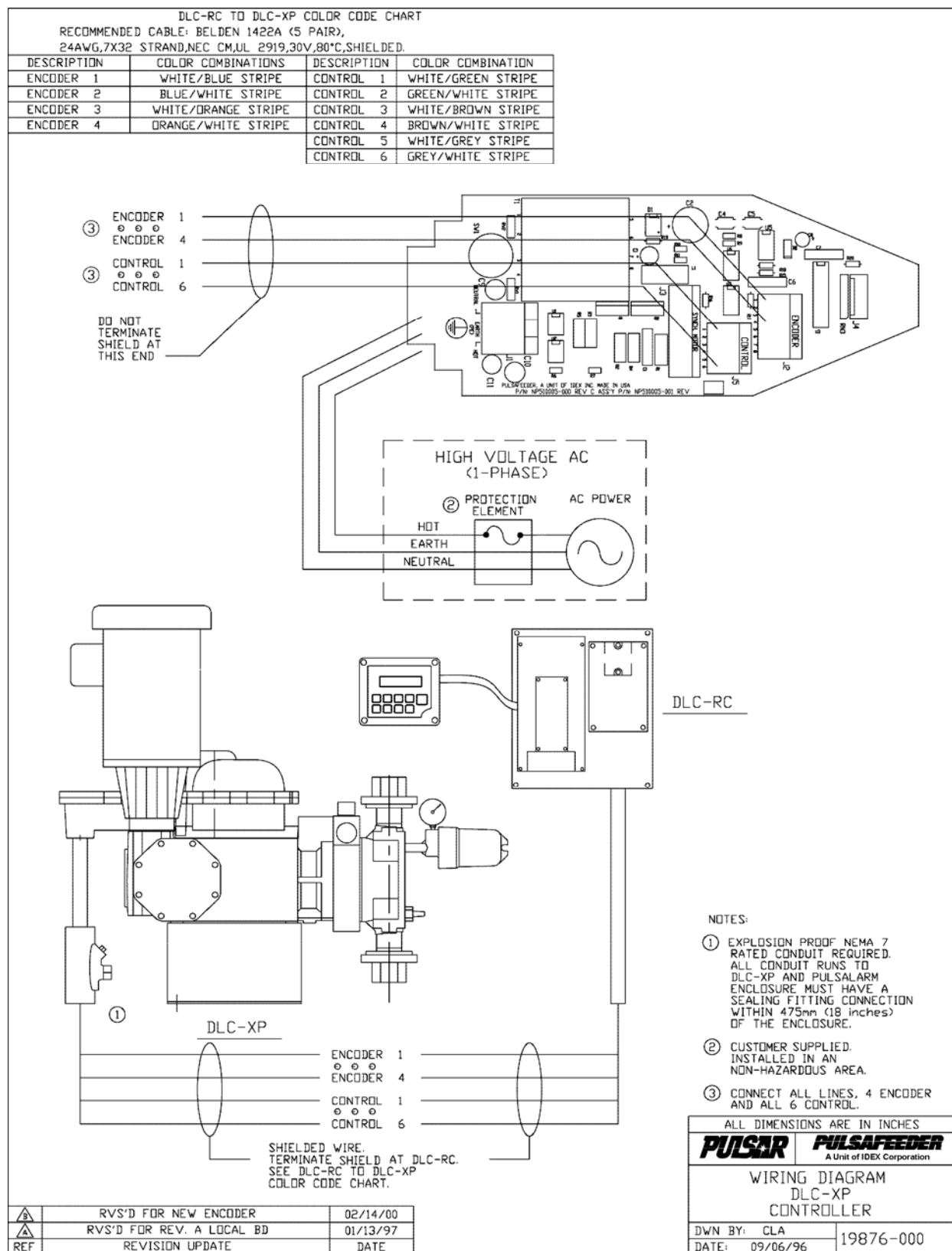


DIAGRAM 2. DLC-XP WIRING DIAGRAM (19565-000).

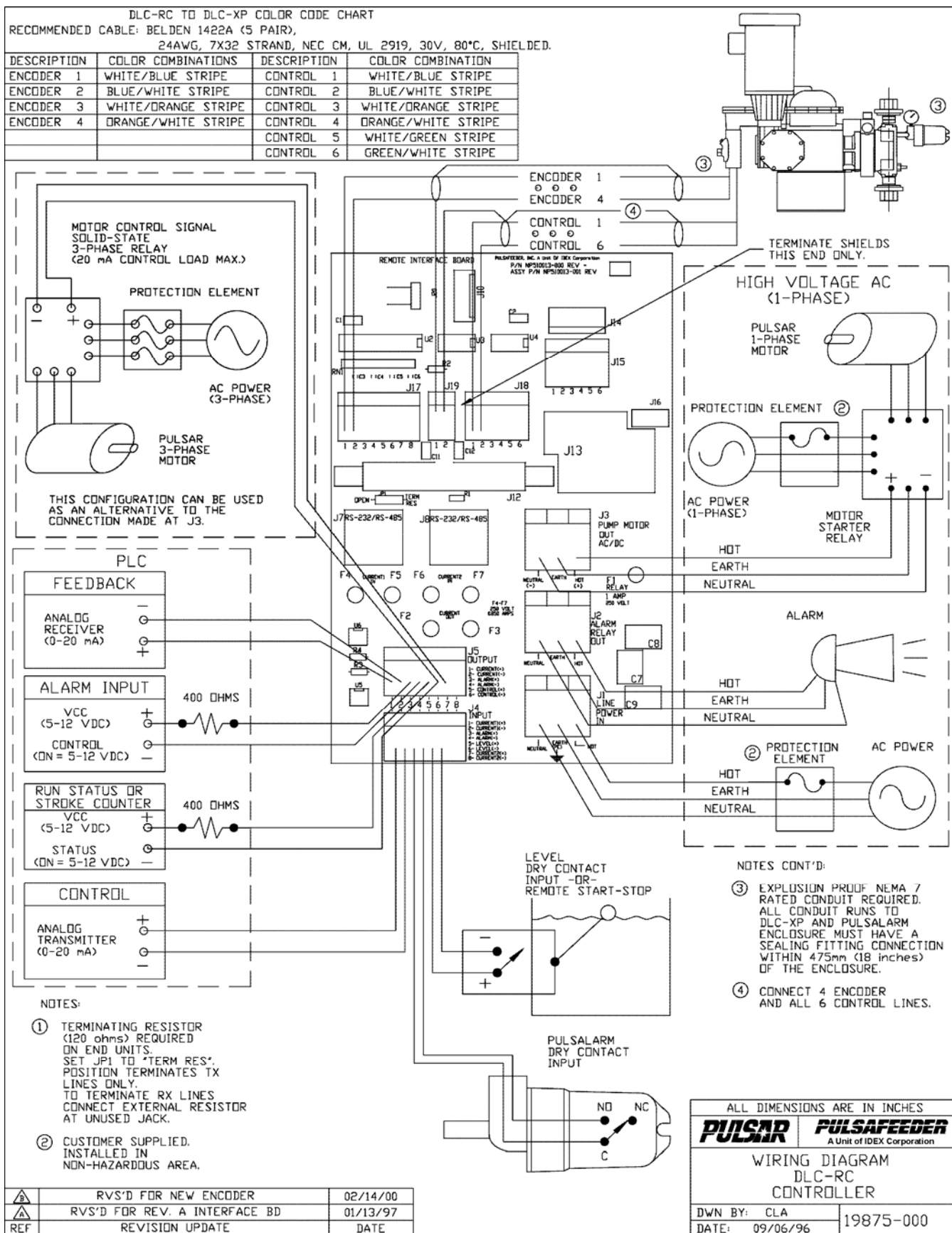


DIAGRAM 3. DLC-RC WIRING DIAGRAM

## 9. Specifications

Turndown Ratio .....	up to 10:1 (application dependent)
Accuracy .....	No added inaccuracy to pump flow.
Resolution .....	0.1%; up to four digits on units of flow.
Response .....	1% per second
Temperature .....	18° C to 40° C (0° F to 104° F) Operation 18° C to 60° C (0° F to 140° F) Storage

### High Voltage Inputs

Line Power (J1) .....	(Factory Configured): 115 VAC +/- 10%, 60 Hz, 10 Amp max. 115 VAC +/- 10%, 50 Hz, 10 Amp max. 230 VAC +/- 10%, 60 Hz, 5 Amp max. 230 VAC +/- 10%, 50 Hz, 5 Amp max.
-----------------------	---

### High Voltage Outputs

Alarm Relay (J2) .....	1 Amp at rated Line Voltage (Fused)
Pump Motor (J3) .....	7 Amps at 115 VAC 3.5 Amps at 230 VAC Must be rated at line Voltage

### Low Voltage Inputs

#### Analog Input (J4-1, J4-2)

Range .....	0 to 25mA / 0 to 5volts
Minimum Span.....	2mA / 0.4 volts
Fuse .....	50mA
Surge Protection .....	7.4 Joules
Isolation.....	500volts from all other I/O and ground
Modes.....	Split Ranging / Reverse Acting / Ratio

#### PULSAlarm (J4-3, J4-4)

Type .....	Dry Contact (Do not apply powered signal)
Modes.....	Normally Open / Normally Closed

#### Digital (J4-5, J4-6)

Type .....	Dry Contact (Do not apply powered signal)
Isolation:.....	Not isolated from PULSAlarm or motor thermostat. 500 volts from all other inputs, outputs and ground.
Modes .....	Normally Open / Normally Closed

## Low Voltage Outputs

### Analog Output

Range / Load.....0 to 20mA / 700ohms Max.  
Minimum Span .....2mA  
Fuse.....50m  
Surge Protection .....7.4 Joules  
Isolation .....500volts from all other I/O and ground  
Modes .....Split Ranging / Reverse Acting

### Alarm Status (J5-3, J5-4)

Type.....Dry Contact (Transistor Type)  
VCE(SAT).....0.3volts  
Max Fwd Current ...50mA  
Maximum voltage...24 VDC  
On-State Resist .....100 ohm  
Isolation .....5000volts from all I/O and ground

### Digital Output (J5-5, J5-6)

Type .....Dry Contact (Transistor Type)  
VCE(SAT) .....0.3volts  
Max Fwd Current ..50mA  
Maximum voltage...24 VDC  
On-State Resist .....100 ohm  
Isolation .....5000volts from all I/O and ground

## DLC-XP to DLC-RC Wiring

### Control & Encoder

Cable Length .....1220m (4000ft) Maximum  
Cable Type.....Belden 1422A 5-Pair/24AWG/7X32 or similar  
Isolation .....500v from ground

## 10. Factory Default Values

### **CALIBRATION**

Pump Flow	1-Point Calibration on PULSAR at Rated Flow and Pressure.
Analog Input	4 - 20mA
Analog Output	4 - 20mA

### **ANALOG INPUT**

Failure Mode	Freeze at last signal / Restore to Analog Mode
Operating Mode	Active

### **LEAK DETECTION**

Inactive

### **LEVEL SWITCH**

Inactive

### **POWER FAILURE**

Motor Off

### **ALARM RELAY**

Normally Open

### **SECURITY**

Type	Off
------	-----

### **DECIMAL FORMAT**

Format	9,999.99
Position	Set at factory. PULSAR dependent (e.g., 9.9999, 0.99999, etc.)

### **LANGUAGE**

English

### **UNITS**

Percent (%)

### **BATCH**

Inactive

Batch #n Rate	0%
Batch #n Duration	0 H 00 M
Batch #n Type	One Time Only

### **DATE/TIME**

Date Format	MM/DD/YY
Time Format	24:00
Daylight Savings	No
Day of Week	Sunday

### **VOLTAGE**

Operating	Set at Factory to Customer Requirement
-----------	--

# 11. Trouble Shooting Guide

## 11.1 System Diagnostics

Your DLC contains extensive diagnostics that allow it to determine the source of common problems. If your DLC is not operating properly, your first course of action should be to review the {DIAGNOSTICS} sub-menu in the {CONFIGURE} menu. To access this menu from the standard operating mode follow this procedure (provided your user interface -- keypad and display -- is functioning):

1. Press [MOTOR] repeatedly until the display reads {MOTOR OFF}.
  2. Cycle power to the DLC (turn the main OFF then ON). This will cause the self-test routine to re-execute.
  3. Press [MENU]. The screen { - MENU - / DIAGNOSTICS-1 } will appear. The value, in this case '1' indicates how many failures were detected.
  4. Press [ENTER] to enter the Diagnostics Menu. The screen {DIAG MENU 1/8 / POWER IN: OK} will appear.
  5. Repeatedly press [UP] to cycle through all eight Diagnostic screens.
  6. If a screen displays a FAIL message, press [ENTER] to display the time and date the failure occurred. Press [ENTER] again to display the clear screen. Press [UP] and then [ENTER] to clear the message.
- Make a note of any failures reported in the Diagnostics Menu. Using this information, proceed with the troubleshooting instructions below:



**Other actions may be necessary to bring the process back to normal conditions before clearing a failure.**

MENU (DIAGNOSTICS)		
Symptom	Probable Cause	Possible Solution
<b>DIAG 1/11 POWER IN: FAIL</b>	The power to the DLC-XP failed while the pump motor was running.	Place DLC-XP in {MOTOR OFF} operating mode before disconnecting power. See POWER trouble shooting.
<b>DIAG 2/11 ANALOG IN: FAIL</b>	The Analog Input signal fell outside of the calibrated range, or fell to 0 within .25 seconds (i.e., the signal was changing by more than 8.8mA per second and was less than .3mA).	Place DLC in {MANUAL MODE} before the signal loss occurs. Re-calibrate Analog Input. Condition Analog Input Signal. See ANALOG INPUT trouble shooting.
<b>DIAG 3/11 DIGITAL: FAIL</b>		
<b>DIAG 4/11 LEAK DET: FAIL</b>	The Leak Detection Switch closure activated according to its configuration.	Review 7-General Operation: Leak Detection Failure Set-up. See LEAK DETECTION trouble shooting.
<b>DIAG 5/11 LEVEL SWITCH: FAIL</b>	The Level Switch closure activated according to its configuration.	Review 7-General Operation: Level Switch Failure Set-up. See DRUM LEVEL trouble shooting.
<b>DIAG 6/11 MOTOR TEMP: FAIL</b>		
<b>DIAG 7/11 DRIVE TEMP: FAIL</b>	The DLC internal temperature has exceeded the units rating.	Re-locate the DLC to a environment with lower ambient temperatures. See 9-Specifications section.



MENU (DIAGNOSTICS – Continued)		
Symptom	Probable Cause	Possible Solution
<b>DIAG 8/11 BATTERY: FAIL</b>	The DLC clock is backed by a Lithium Battery with a 10 year life. The life expectancy is over.	Contact Technical Services.
<b>DIAG 9/11 CIRCUIT: FAIL *RAM*</b>	The Random Access Memory (RAM) on the mother board cannot be reliably read and/or written to.	Cycle Power on unit to double check error. Contact Technical Services.
<b>DIAG 9/11 CIRCUIT: FAIL *EEPROM*</b>	The Electronically Erasable Read Only Memory (EEPROM) on the mother board cannot be reliably read and/or written to.	Cycle Power on unit to double check error. Contact Technical Services.
<b>DIAG 9/11 CIRCUIT: FAIL *MOTOR*</b>	The DLC's internal motor failed to respond when given a command to do so. Cycle Power on unit to double check error. The DLC's internal motor has achieved its Duty Cycle limit: 50% on over a 10 minute interval.	Review MANUAL KNOB / DLC INTERNAL DRIVE MOTOR trouble shooting. Contact Technical Services. Cycle Power to clear. Reduce motor run time by changing batch or conditioning analog input.
<b>DIAG 10/11 RUN TIME</b>		
<b>DIAG 11/11 STROKE COUNT</b>		

DISPLAY		
Symptom	Probable Cause	Possible Solution
<b>No Display Back-lighting</b>	No Power Supplied.	Check power source
	Supply power wired incorrectly.	Check wiring
	Supply power outside of specification.	Check voltage/frequency against spec.
	Low Voltage I/O wired incorrectly.	Check wiring
	Display ribbon cable loose.	Contact Technical Support
	Low Voltage Power Supply failed.	Contact Technical Support
<b>No Text on Display</b>	Contrast out of adjustment.	Adjust with [MENU][UP]or[MENU][DOWN]
	Software did not initiate properly.	Cycle power.
	Memory Corrupted.	Cycle power. Perform Factory Re-Initialize.
	Environment exceeds 40°C (104°F).	Relocate to another area.

POWER		
Symptom	Probable Cause	Possible Solution
<b>No power indicators.</b>	No Power Supplied.	Check power source.
	Supply power wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against specification.
	Low Voltage I/O wired incorrectly.	Check wiring.
	Low Voltage Power Supply failed.	Contact Technical Support

DLC-XP POWER		
Symptom	Probable Cause	Possible Solution
<b>Display: {Check Power}</b>	DLC-XP is not powered.	Check line to DLC-XP
	Control wiring incorrect.	Refer to 5-Installation: Control Connections.

PULSAR MOTOR (1-Phase)		
Symptom	Probable Cause	Possible Solution
<b>Motor will not start.</b>	No Power Supplied.	Check power source to DLC/Starter.
	Motor/Starter wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against spec.
	Motor key not pressed.	Press motor key to start motor.
	Software did not initiate properly.	Cycle power.
	Leak or Drum input set with option MOTOR OFF? set to YES.	Correct Leak or Drum condition. Set MOTOR OFF? to NO.
	PULSAR mechanicals locked.	Check PULSAR, reference IOM.
<b>Motor will not stop.</b>	Solid-State relay failed.	Contact Technical Support.
	Motor/Starter wired incorrectly.	Check wiring.
	Software did not init properly.	Cycle power.
	Motor key not pressed.	Press motor key to stop motor.
	Solid-State relay failed.	Contact Technical Support.

ALARM RELAY		
Symptom	Probable Cause	Possible Solution
<b>Alarm Relay will not activate</b>	Relay wired incorrectly.	Check wiring.
	Relay fuse blown.	Replace with 1A@250VAC.
	Software not configured properly.	Refer to 7-General Operation: Menu

ANALOG INPUT		
Symptom	Probable Cause	Possible Solution
<b>Not responding to Analog (mA) Input</b>	Input wired incorrectly.	Check wiring.
	Input wired to second channel.	Move wires from positions 7 & 8 on J4 to 1 & 2.
	Input fuse(s) blown.	Replace F4 & F5 w/ 50mA@250VAC.
	Not in Analog Operation Mode.	Press [MODE].
	Input not calibrated properly.	Review 7-General Operation: Calibration.
<b>Signal Failure Message Displayed with no signal loss.</b>	Break in wiring.	Check wiring.
	Input outside of specification.	Boost/Condition Signal.
	Process fluctuates too rapidly: < .3mA and changing by more than 8.8mA/s	Condition Signal. Change Failure Mode. Re-calibrate.

PULSAlarm		
Symptom	Probable Cause	Possible Solution
<b>Not responding to PULSAlarm Input</b>	Input wired incorrectly.	Check wiring.
	Input not configured properly.	Review 7-General Operation: Menu, Leak Detection Failure Set-up.
	Powered contact used.	Remove and replace with dry contact. If no change, contact Technical Support.

LEVEL		
Symptom	Probable Cause	Possible Solution
<b>Not responding to Level Input</b>	Input wired incorrectly.	Check wiring.
	Input not configured properly.	Review 7-General Operation: Menu, Drum Level Set-up.
	Powered contact used.	Remove and replace with dry contact. If no change, contact Technical Support.

ANALOG OUTPUT		
Symptom	Probable Cause	Possible Solution
<b>No Analog (mA) Signal Present.</b>	Output wired incorrectly.	Check wiring.
	Output fuse(s) blown.	Replace F2 & F3 w/ 50mA@250VAC.
<b>Not tracking.</b>	Output not calibrated properly.	Review 7-General Operation: Calibration.

ALARM RELAY OUTPUT		
Symptom	Probable Cause	Possible Solution
<b>No Output.</b>	Output wired incorrectly.	Check wiring.
	External Device not powering output.	Refer to wiring diagram. External device must supply voltage to dry contact.
	Alarm Options not set.	Review 7-General Operation: Leak Detection/Drum Level Set-up/Alarm Relay.

MANUAL ADJUSTMENT KNOB / DLC INTERNAL DRIVE MOTOR		
Symptom	Probable Cause	Possible Solution
<b>DLC-XP will not adjust stroke.</b>	PULSAR Stroke Adjustment jammed on mechanical stop at 0%.	Remove DLC-XP. Turn shaft clockwise with crescent wrench on flats to free. Re-install DLC-XP. Re-calibrate.
	PULSAR Stroke Adjustment jammed on mechanical stop at > 100%.	Remove DLC-XP. Turn shaft clockwise with crescent wrench on flats to free. Re-install DLC-XP. Re-calibrate.
	DLC-XP gearing worn.	Contact Technical Support.
<b>DLC-XP will not adjust stroke. Display shows {DUTY CYCLE}.</b>	Internal DLC Synchronous motor has achieved its duty cycle limit of 50% ON time (based on a 10 minute interval). Rapidly cycling batches and wildly swinging analog inputs will cause this motor to run continuously.	Eliminate batches that are cycling too rapidly (e.g., changing stroke from 0 to 100% one minute and 100 to 0% the next - hence the motor runs all the time). Condition analog input signal. Cycle Power. Wait for 5 minute 'cool-down' period.
<b>DLC-XP adjusts at power-up.</b>	Normal Zero Calibration. Display should read {PLEASE WAIT / ZERO CALIBRATE}.	Wait for DLC-XP to complete Zero Calibration.

KEYPAD		
Symptom	Probable Cause	Possible Solution
<b>Display does not respond to keypad entry.</b>	Software did not initiate properly.	Cycle power.
	Memory Corrupted.	Cycle power. Perform Factory Re-Initialize.
	Keypad connector loose.	Contact Technical Support.

BATCH OPERATION		
Symptom	Probable Cause	Possible Solution
<b>Activated batch appears to be running through batches rapidly.</b>	Batch Activated with Old Start Date. For example, today is 4/26/00, You have a repeating batch programmed to start on 4/24/00). The display will show the 'run-through' of all batches between start the start day and time and today.	Change Batch start-time to current or future date/time.
<b>Repeating Batch will not start.</b>	Batch duration is set to 0 hours and 0 minutes.	Duration must be greater than 0 minutes for batch to activate.

CALIBRATION		
Symptom	Probable Cause	Possible Solution
<b>Message: {Terminated / Press any key} appears during Calibration.</b>	Stroke setting adjusted while Calibration session was active.	Do not touch the stroke adjustment mechanism while a Calibration session is active.

UNITS		
Symptom	Probable Cause	Possible Solution
<b>Units do not increment with change in %.</b>	Unit not properly calibrated. Calibration beyond display resolution.	Re-calibrate to value within display range. Change number format to give additional precision.

MISCELLANEOUS		
Symptom	Probable Cause	Possible Solution
<b>Voltage failure message displayed</b>	Incoming Power un-reliable	DLC should have separate branch circuit taken from main. Re-wire. Consider surge-suppression.
	DLC factory configured for operating voltage other than input.	DLC must run under Factory configured operating voltage. Locate source of correct voltage and re-wire.
<b>Power failure message displayed.</b>	PULSAR motor running at time of power loss.	Turn PULSAR motor off before powering DLC down.

ENCODER ERROR		
Symptom	Probable Cause	Possible Solution
<b>Message: {ENCODER ERROR / PRESS ENTER} displays during zero calibration.</b>	DLC-XP to DLC-RC encoder wiring incorrect.	Correct wiring. Refer to section 5-Installation: Control Connections.
	DLC-XP to DLC-RC control wiring incorrect.	Correct wiring. Refer to section 5-Installation:Control Connections.
	Encoder defective.	Contact Technical Services.

Refer to next section - Encoder Diagnostics

## 11.2 Encoder Diagnostics

Whenever the DLC is re-calibrated it first performs a Zero Calibration. The first portion of the {CALIBRATING ZERO} routine is an encoder test. The DLC will increase the stroke adjustment 1%, while monitoring the encoder output. It will then reverse direction and drive the mechanism to the 0% position. During the 1% increase, the DLC reads the encoder output and compares it to the expected value. If, at any time during this process the DLC detects an error it will display:

**ENCODER ERROR ##**  
**PRESS ENTER**

A numerical value between 0 and 15 will display (instead of '##' in the example). Pressing and releasing [UP] will increase the stroke setting one encoder pulse. A new value will display. The value should increase by one count. Repeating the press and release [UP] step should cause the value to increase by one count with each cycle until in the fashion: 0-1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-0-1-2-3-4, etc. Like wise, pressing [DOWN] will reduce the value by one count.

ENCODER ERROR		
Symptom	Probable Cause	Possible Solution
<b>Numbers decrease sequentially with [UP]</b>	Control Wiring Incorrect - motor control pairs swapped.	Check wiring. Refer to section 5-Installation:Control Connections.
<b>Numbers are not sequential</b>	Encoder Wiring Incorrect - encoder output pairs swapped.	Correct wiring. Refer to section 5-Installation:Control Connections.

While the {ENCODER ERROR ##} screen is displaying you can access a further diagnostic by pressing [UP] and [DOWN] simultaneously. This will cause a bit level diagnostic to display:

**EXPECTED 1101**  
**ACTUAL 1101**

Again use individual [UP] and [DOWN] keystrokes to change the value. The bit positions are associated with connector J17 on the DLC-RC and the J2 on the DLC-XP. If we consider the positions of the value in the example above: position #1 = 1, position #2 = 1, position #3 = 0 and position #4 = 1. These 'bit-positions' correlate to 'connector-positions' on J17 and J2:

Bit-Position	Connector-Position
#1 (1XXX)	J17-1 & J17-2 / J2-1 & J2-2
#2 (X1XX)	J17-3 & J17-4 / J2-3 & J2-4
#3 (XX1X)	J17-5 & J17-6 / J2-5 & J2-6
#4 (XXX1)	J17-7 & J17-8 / J2-7 & J2-8

If while pressing [UP] or [DOWN] you notice two bit-positions in which the Expected is consistently opposite from the Actual, then those positions are most likely reversed. If you notice that one are more positions are not changing, then the connections have either not been made (i.e., open circuit) or have been made incorrectly. Again return to 5-Installation:Control Connections.

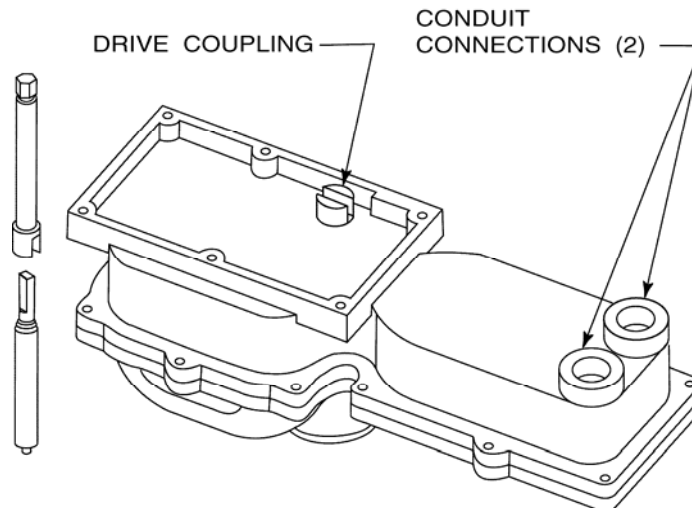
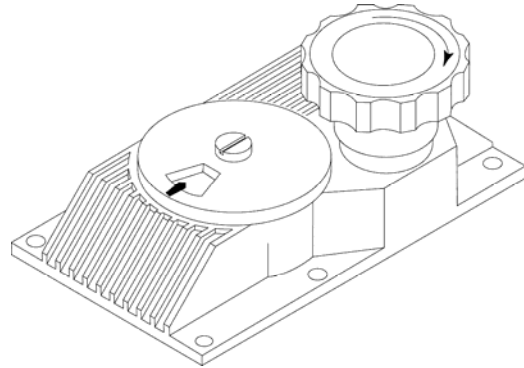
Press [ENTER] to exit the diagnostic display. The DLC will then repeat the test. There is no way to bypass the Encoder Test in the {CALIBRATING ZERO} process.

The encoder is field replaceable, contact your Pulsafeeder Representative for current part number and pricing information if replacement is necessary.

## 12. Conversion (Manual To DLC-XP/RC)

Your PULSAR can be easily converted from a Manual Stroke Adjustment Mechanism to the DLC-XP/RC. The DLC-XP effectively replaces the Manual Cover Assembly. Use the following procedure for conversion:

1. While running the pump motor, adjust the stroke setting to approximately 50%.
2. Disconnect the power supply going to the PULSAR drive motor.
3. Remove the six Phillips Head screws that hold the Manual Cover Assembly to the Eccentric Box (refer to PMP-IOM-96 and the figure to the right). Remove the Manual Cover vertically from the Eccentric Box.
4. Note the position of the adjustment shaft 'flats' They mate with a slot in the DLC-XP output shaft -- the only external moving part on the DLC-XP. Familiarize yourself with these mating components prior to installation (refer to the figure below).
5. Locate the face on the bottom of the DLC-XP that mates with the face of the lip of the eccentric box. The DLC-XP is oriented such that the conduit connections and access panel (with Serial Tag) reside at the rear of the pump (as viewed from the reagent head) near the gear box.
6. Orient the DLC-XP properly at a comfortable height above the pump and align the slot in the DLC-XP coupling with the 'flats' on the adjustment shaft. You may have to turn the adjustment shaft. If necessary, turn it only in the counter clockwise direction.
7. Lower the DLC-XP onto the eccentric box. It may be necessary to tip the DLC-XP slightly towards the motor to clear the motor adapter. With the DLC-XP approximately 25mm (1 inch) above the eccentric box, make a fine adjustment to align the slot in the DLC-XP coupling with the adjustment shaft 'flats.' Once aligned, lower the DLC-XP to mate with the eccentric box. Do not force it! When the coupling is properly aligned, the DLC-XP will slide home under its own weight.
8. Install the 4 DLC-XP mounting screws and washers provided. Remove the 13 wiring access panel screws.
9. Follow the instructions in section 5-Installation: Electrical Wiring of this manual for electrical connections.
10. Perform the steps detailed in Section 6-Start Up Instructions.
11. Review Section 7-General Operation for detailed information on configuring your DLC-XP/RC and its advanced features.



# 13. System Repairs

## 13.1 Emergency Manual Pulsar Operation.

If your DLC-XP/RC is not functioning, you can operate your PULSAR manually without removing the DLC-XP. Follow this procedure:



**THE ATMOSPHERE MUST BE MADE SAFE (I.E., NON-HAZARDOUS) PRIOR TO ATTEMPTING THIS PROCEDURE.**

1. Disconnect the power to the DLC-XP and DLC-RC at the main.
2. Remove wires to J1 LINE POWER and J3 PUMP MOTOR. Use wire nuts or other code approved connectors to attach the LINE HOT to the MOTOR HOT, the LINE EARTH to the MOTOR EARTH, and the LINE NEUTRAL to the MOTOR NEUTRAL.
3. Re-connect the PULSAR power at the main. **Note! The PULSAR motor will start immediately!** Take all necessary precautions.
4. Identify the stroke adjustment shaft as a vertical rod with hex end that protrudes above the lower half of the DLC-XP when the top half is removed. Rotate the stroke adjustment shaft manually clockwise to zero the pump. It will be difficult to rotate as you are back-driving the DLC-XP motor. Be careful! Do not force the knob. Try turning it in both directions to get a feel for the back-drive torque. As you approach zero the knocking will diminish.
5. Once you have found zero, mark the knob and cover with a piece of tape to use as a reference.
6. You can set the stroke adjustment to a specific value by calculating the number of knob turns. To do this, divide the desired setting (%) by a factor of 4 (%/rotation). For example, say your desired setting was 67%. You would divide 67 by 4, which equals 16.75. So you would turn the knob 16 and 3/4 revolutions from the zero position.

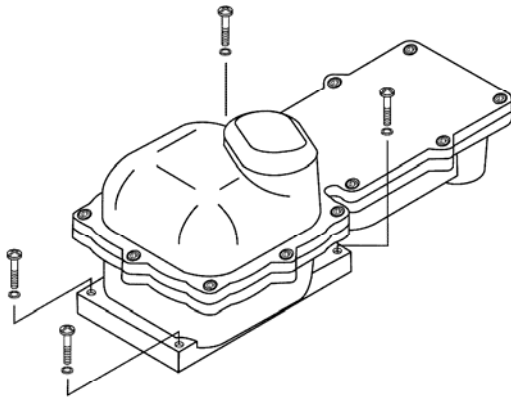
## 13.2 DLC-XP Replacement

The following procedure assumes that you have received your replacement DLC-XP and are ready to perform the replacement.

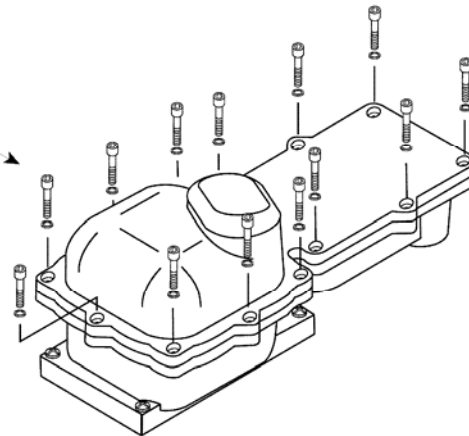
1. If possible, activate the PULSAR motor and adjust the stroke setting in the range of 10 to 90%. Avoid 0 and 100% stroke settings on the PULSAR when replacing a DLC-XP. Do not adjust the stroke setting beyond the 100% (25 turns from 0%) setting.
2. Disconnect the power to the DLC-XP and DLC-RC at the main. Power down all attached equipment (e.g., PLC's).
3. Remove the four bolts that hold the DLC-XP to the PULSAR eccentric box (see Figure 22).
4. Remove the DLC-XP from the Eccentric Box by lifting vertically. Store it in the returnable packaging.
5. Bring the replacement DLC-XP to the installation site.
6. Note the position of the PULSAR adjustment shaft 'flats.' They mate with a slot in the DLC-XP output shaft -- the only external moving part on the DLC-XP. Familiarize yourself with these mating components prior to installation (see Figure 21).
7. Locate the face on the bottom of the DLC-XP that mates with the face of the lip of the eccentric box. The DLC-XP is oriented such that the conduit connections and access panel (with Serial Tag) reside at the rear of the pump (as viewed standing in front of the reagent head looking at the motor) near the gear box.

8. Orient the DLC-XP properly at a comfortable height above the pump and align the slot in the DLC-XP coupling with the 'flats' on the adjustment shaft. You may have to turn the adjustment shaft. If necessary, only turn the adjustment shaft in the counter clockwise direction.
9. Lower the DLC-XP onto the eccentric. It may be necessary to tip the DLC-XP slightly towards the motor to clear the Motor adapter. With the DLC-XP approximately 25mm inch (1 inch) above the eccentric box, make a fine adjustment to align the slot in the DLC-XP coupling with the adjustment shaft 'flats.' Once aligned, lower the DLC-XP to mate with the eccentric box. Do not force the cover! When the coupling is properly aligned, the DLC-XP will slide home under its own weight.
10. Install the 4 DLC-XP mounting screws and washers provided. Remove the 13 top DLC-XP top cover.
11. Follow the instructions in Section 5-Installation: Electrical Wiring for electrical connections.
12. Perform the steps detailed in Section 6-Start-up.
13. Review the section 7-General Operation for detailed information on configuring your DLC and its advanced features.

MOUNTING SCREWS (4)



ENCLOSURE SCREWS (13)





# Appendix A – Quick Start Guide

This 'Quick Start Guide' is intended to provide the minimum amount of information required to install and commission a PULSAR DLC-XP/RC. It is intended for experienced users only. Novice users should review the entire manual. The notation 'PULSAR IOM' refers to the PULSAR Installation Operation Maintenance Instruction Manual provided with your PULSAR metering pump.

## Preparing...

1. Review the 'Before You Begin' section and all applicable safety information.
2. Refer to the PULSAR Installation Operation Maintenance Instruction for proper placement of your pump and related piping. The DLC should be installed in an area protected from direct sunlight and with an ambient temperature range of 0 - 120 Degrees Fahrenheit (-32 to 50 Centigrade).
3. If your pump was supplied with the motor and DLC pre-installed, skip to the Wiring... section below.
4. Follow the INSTALLATION and EQUIPMENT STARTUP sections of the PULSAR IOM. Be sure your PULSAR is operating correctly prior to DLC installation.
5. Apply power to the PUMP motor and manually adjust the stroke setting to 0%.
6. Shut off the motor. Disconnect all pump and controller related power at the main.
7. Remove the manual cover by removing the 6 retaining screws and lifting the cover straight up off the pump.

You are now ready to install the DLC-XP/RC

## Installation:

1. Note the position of the adjustment shaft 'T.' It mates with a slot in output shaft -- the only external moving part on the DLC-XP/RC. The output shaft is connected to the adjustment knob. Familiarize yourself with these mating components prior to installation.
2. Locate the face on the bottom of the DLC-XP/RC that mates with the face of the lip of the eccentric box. The DLC-XP/RC is oriented such that the control pad and display sit to the left of the pump's reagent head (as viewed standing in front of the reagent head looking at the motor). The conduit connections and access panel (with Serial Tag) reside at the rear of the pump near the gear box.
3. Orient the DLC-XP/RC properly at a comfortable height above the pump and align the slot in the DLC-XP/RC coupling with the 'T' on the adjustment shaft by turning the black hand knob on the DLC-XP/RC. Do not turn the 'T'!
4. Lower the DLC-XP/RC onto the eccentric. It may be necessary to tip the DLC-XP/RC slightly towards the motor to clear the Motor adapter. With the DLC-XP/RC approximately 1 inch (25.4mm) above the eccentric box, make a fine adjustment to align the DLC-XP/RC coupling with the adjustment shaft 'T.' Once aligned, lower the DLC-XP/RC to mate with the eccentric box. Do not force the cover! When the coupling is properly aligned, the DLC-XP/RC will slide home under its own weight.
5. Install the 4 DLC-XP/RC mounting screws provided. Remove the 4 wiring access panel screws.

## Wiring Connections

1. Install a separate 15Amp breaker at the wiring panel to supply the DLC-XP/RC and pump motor. Use 18 AWG wire size or larger. Attach the supply to the J1 terminal block labeled 'POWER IN.' Make 3 connections: Neutral, Earth (ground) and Hot as labeled.
2. Connect the pump motor to the J3 terminal block labeled 'MOTOR AC/DC.' Use 18 AWG wire size or larger. The pump motor must be wired to operate at the DLC-XP/RC supply voltage (i.e., if the power supplied to J1 is 110VAC 60Hz, then the motor must operate on 110VAC at 60Hz). If the pump operates at a voltage different than that supplied to the DLC-XP/RC a motor starter must be used. In this case wire the motor starter relay to J3. Double check all connections to confirm good electrical contact between terminal block clamp and bare wire.
3. Clean the mating flange surface on the cover and base with de-greaser and a clean cloth. Inspect the o-ring in the cover to assure it is properly installed in the receiving groove. Replace the DLC-XP cover. Be careful to properly align the cover on its alignment pins. Do not force the cover as difficulty in assembly indicates mis-alignment. Hand tighten the 13 retaining screws. Check the cover joint using a 0.0015in (0.038mm) feeler gage. Clearance should be less than 0.0015in (0.038mm) such that the feeler gage will not enter the joint more than 0.125in (3.2mm) at any point. If necessary, torque the cover bolts to a maximum of 100in-lb (11.3N-m).
4. Apply power to the DLC-XP/RC. The display will illuminate yellow and text will appear. The knob may begin turning -- it is normal for the DLC-XP/RC to perform a zero adjust upon first power-up.
5. Press the Calibrate Button and perform a 1-point (or more) calibration. Follow the on-screen prompts.

Your DLC-XP/RC is now ready for use...

**NOTES:**



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Rev C